

BIBLIOGRAPHY

- Allami, T., Alamiery, A., Nassir, M.H. dan Kadhum, A.H. (2021) “Investigating physio-thermo-mechanical properties of polyurethane and thermoplastics nanocomposite in various applications,” *Polymers*, 13(15), hal. 1–24.
<https://doi.org/10.3390/polym13152467>.
- Arifvianto, B., Wirawan, Y.B., Salim, U.A., Suyitno, S. dan Mahardika, M. (2021a) “Effects of extruder temperatures and raster orientations on mechanical properties of the FFF-processed polylactic-acid (PLA) material,” *Rapid Prototyping Journal*, 27(10), hal. 1761–1775. <https://doi.org/10.1108/RPJ-10-2019-0270>.
- Arifvianto, B., Iman, T.N., Prayoga, B.T., Dharmastiti, R., Salim, U.A., Mahardika, M. dan Suyitno (2021b) “Tensile properties of the FFF-processed thermoplastic polyurethane (TPU) elastomer,” *The International Journal of Advanced Manufacturing Technology*, 117(5–6), hal. 1709–1719.
<https://doi.org/10.1007/s00170-021-07712-0>.
- Arifvianto, B., Satiti, B.E., Salim, U.A., Suyitno, Nuryanti, A. dan Mahardika, M. (2022) “Mechanical properties of the FFF sandwich-structured parts made of PLA/TPU multi-material,” *Progress in Additive Manufacturing*, 7(6), hal. 1213–1223. <https://doi.org/10.1007/s40964-022-00295-6>.
- Armentano, I., Bitinis, N., Fortunati, E., Mattioli, S., Rescignano, N., Verdejo, R., Lopez-Manchado, M.A. dan Kenny, J.M. (2013) “Multifunctional nanostructured PLA materials for packaging and tissue engineering,” *Progress in Polymer Science*, 38(10–11), hal. 1720–1747.
<https://doi.org/10.1016/j.progpolymsci.2013.05.010>.
- ASTM (2013) “D1238-13 Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer,” *Norma*, 08, hal. 1–16. <https://doi.org/10.1520/D1238-13>.
- ASTM (2017) “Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials. D790,” *Annual Book of ASTM Standards*, hal. 1–12. <https://doi.org/10.1520/D0790-17>.
- Awaja, F., Gilbert, M., Kelly, G., Fox, B. dan Pigram, P.J. (2009) “Adhesion of polymers,” *Progress in Polymer Science (Oxford)*, 34(9), hal. 948–968.
<https://doi.org/10.1016/j.progpolymsci.2009.04.007>.
- Azad, M.A., Olawuni, D., Kimbell, G., Badruddoza, A.Z.M., Hossain, M.S. dan Sultana, T. (2020) *Polymers for extrusion-based 3D printing of pharmaceuticals*:

<https://doi.org/10.3390/pharmaceutics12020124>.

- Azmi, M.S., Hasan, R., Ismail, R., Rosli, N.A. dan Alkahari, M.R. (2018) “Static and dynamic analysis of FDM printed lattice structures for sustainable lightweight material application,” *Progress in Industrial Ecology, an International Journal*, 12(3), hal. 247–259. <https://doi.org/10.1504/PIE.2018.097063>.
- Baca, D. dan Ahmad, R. (2020) “The impact on the mechanical properties of multi-material polymers fabricated with a single mixing nozzle and multi-nozzle systems via fused deposition modeling,” *International Journal of Advanced Manufacturing Technology*, 106(9–10), hal. 4509–4520. <https://doi.org/10.1007/s00170-020-04937-3>.
- Bartolai, J., Simpson, T.W. dan Xie, R. (2018) “Predicting strength of additively manufactured thermoplastic polymer parts produced using material extrusion,” *Rapid Prototyping Journal*, 24(2), hal. 321–332. <https://doi.org/10.1108/RPJ-02-2017-0026>.
- Bednarz, E.T. dan Mulligan, R.R. (2020) “Investigation of a cross-section with a constant transverse shear stress distribution using a numerical approach,” *Applied System Innovation*, 3(1), hal. 1–11. <https://doi.org/10.3390/asi3010003>.
- Boulaala, M., Elmessaoudi, D., Buj-Corral, I., El Mesbahi, J., Ezbakhe, O., Astito, A., El Mrabet, M. dan El Mesbahi, A. (2020) “Towards design of mechanical part and electronic control of multi-material/multicolor fused deposition modeling 3D printing,” *International Journal of Advanced Manufacturing Technology*, 110(1–2), hal. 45–55. <https://doi.org/10.1007/s00170-020-05847-0>.
- Brancewicz-Steinmetz, E., Sawicki, J. dan Byczkowska, P. (2021) “The influence of 3d printing parameters on adhesion between polylactic acid (Pla) and thermoplastic polyurethane (tpu),” *Materials*, 14(21). <https://doi.org/10.3390/ma14216464>.
- Brischetto, S., Ferro, C.G., Torre, R. dan Maggiore, P. (2018) “3D FDM production and mechanical behavior of polymeric sandwich specimens embedding classical and honeycomb cores,” *Curved and Layered Structures*, 5(1), hal. 80–94. <https://doi.org/10.1515/cls-2018-0007>.
- Buj-Corral, I., Bagheri, A. dan Sivatte-Adroer, M. (2021) “Effect of printing parameters on dimensional error, surface roughness and porosity of FFF printed parts with grid structure,” *Polymers*, 13(8). <https://doi.org/10.3390/polym13081213>.
- Çakan, B.G. (2021) “Effects of raster angle on tensile and surface roughness properties

- of various FDM filaments,” *Journal of Mechanical Science and Technology*, 35(8), hal. 3347–3353. <https://doi.org/10.1007/s12206-021-0708-8>.
- Cano-Vicent, A., Tambuwala, M.M., Hassan, S.S., Barh, D., Aljabali, A.A.A., Birkett, M., Arjunan, A. dan Serrano-Aroca, Á. (2021) “Fused deposition modelling: Current status, methodology, applications and future prospects,” *Additive Manufacturing*, 47(August). <https://doi.org/10.1016/j.addma.2021.102378>.
- Carrasco, F., Pagès, P., Gámez-Pérez, J., Santana, O.O. dan MasPOCH, M.L. (2010) “Processing of poly(lactic acid): Characterization of chemical structure, thermal stability and mechanical properties,” *Polymer Degradation and Stability*, 95(2), hal. 116–125. <https://doi.org/10.1016/j.polymdegradstab.2009.11.045>.
- Chacón, J.M., Caminero, M.A., García-Plaza, E. dan Núñez, P.J. (2017) “Additive manufacturing of PLA structures using fused deposition modelling: Effect of process parameters on mechanical properties and their optimal selection,” *Materials and Design*, 124, hal. 143–157. <https://doi.org/10.1016/j.matdes.2017.03.065>.
- Chalgham, A., Ehrmann, A. dan Wickenkamp, I. (2021) “Mechanical properties of fdm printed pla parts before and after thermal treatment,” *Polymers*, 13(8). <https://doi.org/10.3390/polym13081239>.
- Chen, H., Yang, X., Chen, L., Wang, Y. dan Sun, Y. (2016) “Application of FDM three-dimensional printing technology in the digital manufacture of custom edentulous mandible trays,” *Scientific Reports*, 6(January), hal. 1–6. <https://doi.org/10.1038/srep19207>.
- Chokshi, H., Shah, D.B., Patel, K.M. dan Joshi, S.J. (2022) “Experimental investigations of process parameters on mechanical properties for PLA during processing in FDM,” *Advances in Materials and Processing Technologies*, 8(sup2), hal. 696–709. <https://doi.org/10.1080/2374068X.2021.1946756>.
- Ćwikła, G., Grabowik, C., Kalinowski, K., Paprocka, I. dan Ociepa, P. (2017) “The influence of printing parameters on selected mechanical properties of FDM/FFF 3D-printed parts,” *IOP Conference Series: Materials Science and Engineering*, 227(1). <https://doi.org/10.1088/1757-899X/227/1/012033>.
- Dawoud, M., Taha, I. dan Ebeid, S.J. (2016) “Mechanical behaviour of ABS: An experimental study using FDM and injection moulding techniques,” *Journal of Manufacturing Processes*, 21, hal. 39–45. <https://doi.org/10.1016/j.jmapro.2015.11.002>.

- Deblieck, R.A.C., Van Beek, D.J.M., Remerie, K. dan Ward, I.M. (2011) "Failure mechanisms in polyolefines: The role of crazing, shear yielding and the entanglement network," *Polymer*, 52(14), hal. 2979–2990.
<https://doi.org/10.1016/j.polymer.2011.03.055>.
- Dev, S. dan Srivastava, R. (2021) "Optimization of fused deposition modeling (FDM) process parameters for flexural strength," *Materials Today: Proceedings*, 44, hal. 3012–3016. <https://doi.org/10.1016/j.matpr.2021.02.436>.
- Dey, A., Eagle, I.N.R. dan Yodo, N. (2021) "A review on filament materials for fused filament fabrication," *Journal of Manufacturing and Materials Processing*, 5(3). <https://doi.org/10.3390/jmmp5030069>.
- Dezaki, M.L., Ariffin, M.K.A.M., Serjouei, A., Zolfagharian, A., Hatami, S. dan Bodaghi, M. (2021) "Influence of infill patterns generated by cad and fdm 3d printer on surface roughness and tensile strength properties," *Applied Sciences (Switzerland)*, 11(16). <https://doi.org/10.3390/app11167272>.
- Eom, R.I., Lee, H. dan Lee, Y. (2019) "Evaluation of thermal properties of 3D spacer technical materials in cold environments using 3D printing technology," *Polymers*, 11(9), hal. 1–12. <https://doi.org/10.3390/polym11091438>.
- Espalin, D., Ramirez, J.A., Medina, F. dan Wicker, R. (2014) "Multi-material, multi-technology FDM: Exploring build process variations," *Rapid Prototyping Journal*, 20(3), hal. 236–244. <https://doi.org/10.1108/RPJ-12-2012-0112>.
- Farah, S., Anderson, D.G. dan Langer, R. (2016) "Physical and mechanical properties of PLA, and their functions in widespread applications — A comprehensive review," *Advanced Drug Delivery Reviews*, 107, hal. 367–392.
<https://doi.org/10.1016/j.addr.2016.06.012>.
- Fina, F., Goyanes, A., Gaisford, S. dan Basit, A.W. (2017) "Selective laser sintering (SLS) 3D printing of medicines," *International Journal of Pharmaceutics*, 529(1–2), hal. 285–293. <https://doi.org/10.1016/j.ijpharm.2017.06.082>.
- Frank, D., Chandra, R.L. dan Schmitt, R. (2015) "An Investigation of Cause-and-Effect Relationships Within a 3D-Printing System and the Applicability of Optimum Printing Parameters from Experimental Models to Different Printing Jobs," *3D Printing and Additive Manufacturing*, 2(3), hal. 131–139.
<https://doi.org/10.1089/3dp.2015.0010>.
- Freund, R., Watschke, H., Heubach, J. dan Vietor, T. (2019) "Determination of influencing factors on interface strength of additively manufactured multi-material

parts by material extrusion,” *Applied Sciences (Switzerland)*, 9(9).

<https://doi.org/10.3390/app9091782>.

Frick, A. dan Rochman, A. (2004) “Characterization of TPU-elastomers by thermal analysis (DSC),” *Polymer Testing*, 23(4), hal. 413–417.

<https://doi.org/10.1016/j.polymertesting.2003.09.013>.

Fu, X., Zhang, X. dan Huang, Z. (2021) “Axial crushing of Nylon and Al/Nylon hybrid tubes by FDM 3D printing,” *Composite Structures*, 256(June 2020), hal. 113055.

<https://doi.org/10.1016/j.compstruct.2020.113055>.

Galante, J., Ramalho, G.M.F., dos Reis, M.Q., Carbas, R.J.C., Marques, E.A.S. dan da Silva, L.F.M. (2021) “Mechanical Characterization of 3D Printed Specimens,” in L.F.M. da Silva (ed.) *Materials Design and Applications III*. Cham: Springer International Publishing, hal. 149–165. https://doi.org/10.1007/978-3-030-68277-4_11.

Ghilan, A., Chiriac, A.P., Nita, L.E., Rusu, A.G., Neamtu, I. dan Chiriac, V.M. (2020) “Trends in 3D Printing Processes for Biomedical Field: Opportunities and Challenges,” *Journal of Polymers and the Environment*, 28(5), hal. 1345–1367.

<https://doi.org/10.1007/s10924-020-01722-x>.

Gibson, I., Rosen, D., Stucker, B. dan Khorasani, M. (2021) *Additive Manufacturing Technologies, JOURNAL OF THE JAPAN WELDING SOCIETY*. Cham: Springer International Publishing. <https://doi.org/10.1007/978-3-030-56127-7>.

Gibson, I., Rosen, D. dan Stucker, B. (2015) “Direct Digital Manufacturing,” in *Additive Manufacturing Technologies*. New York, NY: Springer New York, hal. 375–397. https://doi.org/10.1007/978-1-4939-2113-3_16.

Gordobil, O., Egüés, I., Llano-Ponte, R. dan Labidi, J. (2014) “Physicochemical properties of PLA lignin blends,” *Polymer Degradation and Stability*, 108, hal. 330–338. <https://doi.org/10.1016/j.polymdegradstab.2014.01.002>.

Han, D. dan Lee, H. (2020) “Recent advances in multi-material additive manufacturing: methods and applications,” *Current Opinion in Chemical Engineering*, 28, hal. 158–166. <https://doi.org/10.1016/j.coche.2020.03.004>.

Han, S.H., Cha, M., Jin, Y.-Z., Lee, K.-M. dan Lee, J.H. (2020) “{BMP}-2 and {hMSC} dual delivery onto 3D printed {PLA}-Biogel scaffold for critical-size bone defect regeneration in rabbit tibia,” *Biomedical Materials*, 16(1), hal. 15019. <https://doi.org/10.1088/1748-605x/aba879>.

Hanon, M.M., Dobos, J. dan Zsidai, L. (2020) “The influence of 3D printing process

- parameters on the mechanical performance of PLA polymer and its correlation with hardness,” *Procedia Manufacturing*, 54, hal. 244–249.
<https://doi.org/10.1016/j.promfg.2021.07.038>.
- Harris, M., Potgieter, J., Archer, R. dan Arif, K.M. (2019) “In-process thermal treatment of polylactic acid in fused deposition modelling,” *Materials and Manufacturing Processes*, 34(6), hal. 701–713. <https://doi.org/10.1080/10426914.2019.1566611>.
- Hasanov, S., Alkunte, S., Rajeshirke, M., Gupta, A., Huseynov, O., Fidan, I., Alifui-Segbaya, F. dan Rennie, A. (2021) “Review on Additive Manufacturing of Multi-Material Parts: Progress and Challenges,” *Journal of Manufacturing and Materials Processing*, 6(1), hal. 4. <https://doi.org/10.3390/jmmp6010004>.
- Hergel, J. dan Lefebvre, S. (2014) “Clean color: Improving multi-filament 3D prints,” *Computer Graphics Forum*, 33(2), hal. 469–478.
<https://doi.org/https://doi.org/10.1111/cgf.12318>.
- Hibbeler, R.C. (2011) *Mechanics of Materials*. 8th Editio. Prentice Hall PTR. Tersedia pada: <https://books.google.co.id/books?id=JME9qAAACAAJ>.
- Hodžić, D., Pandžić, A., Hajro, I. dan Tasić, P. (2020) “Strength comparison of FDM 3D printed PLA made by different manufacturers,” *TEM Journal*, 9(3), hal. 966–970. <https://doi.org/10.18421/TEM93-18>.
- Hong, C., Zhang, Y. dan Borana, L. (2019) “Design, fabrication and testing of a 3D printed FBG pressure sensor,” *IEEE Access*, 7, hal. 38577–38583.
<https://doi.org/10.1109/ACCESS.2019.2905349>.
- Hou, P., Zhao, H., Ma, Z., Zhang, S., Li, J., Dong, X., Sun, Y. dan Zhu, Z. (2016) “Influence of punch radius on elastic modulus of three-point bending tests,” *Advances in Mechanical Engineering*, 8(5), hal. 168781401664911.
<https://doi.org/10.1177/1687814016649116>.
- Hsueh, M.H., Lai, C.J., Liu, K.Y., Chung, C.F., Wang, S.H., Pan, C.Y., Huang, W.C., Hsieh, C.H. dan Zeng, Y.S. (2021) “Effects of printing temperature and filling percentage on the mechanical behavior of fused deposition molding technology components for 3d printing,” *Polymers*. <https://doi.org/10.3390/polym13172910>.
- Huang, C., Chen, R., Ke, Q., Morsi, Y., Zhang, K. dan Mo, X. (2011) “Electrospun collagen–chitosan–TPU nanofibrous scaffolds for tissue engineered tubular grafts,” *Colloids and Surfaces B: Biointerfaces*, 82(2), hal. 307–315.
<https://doi.org/10.1016/j.colsurfb.2010.09.002>.
- ISO/ASTM (2015) “Standard Terminology for Additive Manufacturing – General

Principles – Terminology (ASTM52900),” *International Organization for*

Standardization: Geneva, Switzerland, hal. 1–9. Tersedia pada:

<https://www.iso.org/obp/ui/#iso:std:iso-astm:52900:ed-1:v1:en>.

Jalalvandi, E., Ghanbari, T., Cherghibidsorkhi, H., Zeimaran, E. dan Ilbeygi, H. (2013)

“Processing, Thermal Behavior and Tensile Properties of PLA/Thermoplastic Starch/Montmorillonite Nanocomposites,” *Advanced Materials Research*, 684, hal. 75–79. <https://doi.org/10.4028/www.scientific.net/AMR.684.75>.

Kahraman, Y., Alkan Goksu, Y., Özdemir, B., Eker Gümüş, B. dan Nofar, M. (2022)

“Composition design of PLA/TPU emulsion blends compatibilized with multifunctional epoxy-based chain extender to tackle high impact resistant ductile structures,” *Journal of Applied Polymer Science*, 139(12), hal. 51833. <https://doi.org/https://doi.org/10.1002/app.51833>.

Kaur, G., Singari, R.M. dan Kumar, H. (2021) “A review of fused filament fabrication (FFF): Process parameters and their impact on the tribological behavior of polymers (ABS),” *Materials Today: Proceedings*, 51, hal. 854–860.

<https://doi.org/10.1016/j.matpr.2021.06.274>.

Kaveh, M., Badrossamay, M., Foroozmehr, E. dan Hemasian Etefagh, A. (2015)

“Optimization of the printing parameters affecting dimensional accuracy and internal cavity for HIPS material used in fused deposition modeling processes,” *Journal of Materials Processing Technology*, 226, hal. 280–286.

<https://doi.org/10.1016/j.jmatprotec.2015.07.012>.

Kechagias, J.D., Vidakis, N. dan Petousis, M. (2021) “Parameter effects and process modeling of FFF-TPU mechanical response,” *Materials and Manufacturing Processes* [Preprint].

<https://doi.org/10.1080/10426914.2021.2001523>.

Keleş, Ö., Blevins, C.W. dan Bowman, K.J. (2017) “Effect of build orientation on the mechanical reliability of 3D printed ABS,” *Rapid Prototyping Journal*, 23(2), hal. 320–328.

<https://doi.org/10.1108/RPJ-09-2015-0122>.

Kim, H., Park, E., Kim, S., Park, B., Kim, N. dan Lee, S. (2017) “Experimental Study on Mechanical Properties of Single- and Dual-material 3D Printed Products,”

Procedia Manufacturing, 10, hal. 887–897.

<https://doi.org/10.1016/j.promfg.2017.07.076>.

Kim, H.H., Mazumder, M., Lee, S.J. dan Lee, M.S. (2020) “Laboratory evaluation of sustainable PMA binder containing styrene-isoprene-styrene (SIS) and thermoplastic polyurethane,” *Sustainability (Switzerland)*, 12(23), hal. 1–14.

<https://doi.org/10.3390/su122310057>.

- Kluska, E., Gruda, P. dan Majca-Nowak, N. (2018) “The Accuracy and the Printing Resolution Comparison of Different 3D Printing Technologies,” *Transactions on Aerospace Research*, 2018(3), hal. 69–86. <https://doi.org/10.2478/tar-2018-0023>.
- Koprnický, J., Šafka, J. dan Ackermann, M. (2018) “Using of 3D Printing Technology in Low Cost Prosthetics,” *Materials Science Forum*, 919, hal. 199–206. <https://doi.org/10.4028/www.scientific.net/MSF.919.199>.
- Kumar Mishra, P. dan P, S. (2020) “Prediction of in-plane stiffness of multi-material 3D printed laminate parts fabricated by FDM process using CLT and its mechanical behaviour under tensile load,” *Materials Today Communications*, 23(December 2019), hal. 100955. <https://doi.org/10.1016/j.mtcomm.2020.100955>.
- Kumar, P., Rajak, D.K., Abubakar, M., Ali, S.G.M. dan Hussain, M. (2021) “3D Printing Technology for Biomedical Practice: A Review,” *Journal of Materials Engineering and Performance*, 30(7), hal. 5342–5355. <https://doi.org/10.1007/s11665-021-05792-3>.
- Kumar, R., Singh, R. dan Farina, I. (2018) “On the 3D printing of recycled ABS, PLA and HIPS thermoplastics for structural applications,” *PSU Research Review*, 2(2), hal. 115–137. <https://doi.org/10.1108/PRR-07-2018-0018>.
- Kumar, S., Singh, I., R. Koloor, S.S., Kumar, D. dan Yahya, M.Y. (2022) “On Laminated Object Manufactured FDM-Printed ABS/TPU Multimaterial Specimens: An Insight into Mechanical and Morphological Characteristics,” *Polymers*, 14(19), hal. 4066. <https://doi.org/10.3390/polym14194066>.
- Kusuma, D.B., Mahardika, M., Pratama, J., Salim, U.A., Cahyono, S.I. dan Arifvianto, B. (2022) “Metode Pencegahan Warping dan Cacat Kualitas Permukaan Produk Fused Deposition Modelling (FDM),” *Conference SENATIK STT Adisutjipto Yogyakarta*, 7, hal. 47–56. <https://doi.org/10.28989/senatik.v7i0.455>.
- Lai, S.M., Wu, W.L. dan Wang, Y.J. (2016) “Annealing effect on the shape memory properties of polylactic acid (PLA)/thermoplastic polyurethane (TPU) bio-based blends,” *Journal of Polymer Research*, 23(5). <https://doi.org/10.1007/s10965-016-0993-6>.
- Lauwers, B., Klocke, F., Klink, A., Tekkaya, A.E., Neugebauer, R. dan McIntosh, D. (2014) “Hybrid processes in manufacturing,” *CIRP Annals - Manufacturing Technology*, 63(2), hal. 561–583. <https://doi.org/10.1016/j.cirp.2014.05.003>.
- León-Calero, M., Reyburn Valés, S.C., Marcos-Fernández, Á. dan Rodríguez-

- Hernandez, J. (2021) "3D printing of thermoplastic elastomers: Role of the chemical composition and printing parameters in the production of parts with controlled energy absorption and damping capacity," *Polymers*, 13(20).
<https://doi.org/10.3390/polym13203551>.
- Li, H., Wang, T., Sun, J. dan Yu, Z. (2018) "The effect of process parameters in fused deposition modelling on bonding degree and mechanical properties," *Rapid Prototyping Journal*, 24(1), hal. 80–92. <https://doi.org/10.1108/RPJ-06-2016-0090>.
- Liao, Y., Liu, C., Coppola, B., Barra, G., Di Maio, L., Incarnato, L. dan Lafdi, K. (2019) "Effect of Porosity and Crystallinity on 3D Printed PLA Properties," *Polymers*, 11(9), hal. 1487. <https://doi.org/10.3390/polym11091487>.
- Lin, W., Shen, H., Xu, G., Zhang, L., Fu, J. dan Deng, X. (2018) "Single-layer temperature-adjusting transition method to improve the bond strength of 3D-printed PCL/PLA parts," *Composites Part A: Applied Science and Manufacturing*, 115, hal. 22–30. <https://doi.org/10.1016/j.compositesa.2018.09.008>.
- Liu, B., Huang, L., Geng, L. dan Yin, F. (2018) "Multiscale Hierarchical Structure and Laminated Strengthening and Toughening Mechanisms," in *Lamination - Theory and Application*. InTech. <https://doi.org/10.5772/intechopen.69976>.
- Liu, Q., Zhang, Z., Yavas, D., Shen, W. dan Wu, D. (2022) "Multi-material additive manufacturing: effect of process parameters on flexural behavior of soft-hard sandwich beams," *Rapid Prototyping Journal* [Preprint], (July).
<https://doi.org/10.1108/RPJ-07-2022-0231>.
- Liu, X., Zhang, M., Li, S., Si, L., Peng, J. dan Hu, Y. (2017) "Mechanical property parametric appraisal of fused deposition modeling parts based on the gray Taguchi method," *International Journal of Advanced Manufacturing Technology*, 89(5–8), hal. 2387–2397. <https://doi.org/10.1007/s00170-016-9263-3>.
- Long, J., Gholizadeh, H., Lu, J., Bunt, C. dan Seyfoddin, A. (2017) "Application of Fused Deposition Modelling (FDM) Method of 3D Printing in Drug Delivery," *Current Pharmaceutical Design*, 23(3), hal. 433–439.
<https://doi.org/10.2174/1381612822666161026162707>.
- Lopes, L.R., Silva, A.F. dan Carneiro, O.S. (2018) "Multi-material 3D printing: The relevance of materials affinity on the boundary interface performance," *Additive Manufacturing*, 23(June), hal. 45–52.
<https://doi.org/10.1016/j.addma.2018.06.027>.

- Lopez, D.M.B. dan Ahmad, R. (2020) "Tensile mechanical behaviour of multi-polymer sandwich structures via fused deposition modelling," *Polymers*, 12(3).
<https://doi.org/10.3390/polym12030651>.
- Lumpe, T.S., Mueller, J. dan Shea, K. (2019) "Tensile properties of multi-material interfaces in 3D printed parts," *Materials and Design*, 162, hal. 1–9.
<https://doi.org/10.1016/j.matdes.2018.11.024>.
- Manero, A., Smith, P., Sparkman, J., Dombrowski, M., Courbin, D., Kester, A., Womack, I. dan Chi, A. (2019) "Implementation of 3D printing technology in the field of prosthetics: Past, present, and future," *International Journal of Environmental Research and Public Health*, 16(9).
<https://doi.org/10.3390/ijerph16091641>.
- Mathew, E., Pitzanti, G., Larrañeta, E. dan Lamprou, D.A. (2020) "Three-dimensional printing of pharmaceuticals and drug delivery devices," *Pharmaceutics*, 12(3), hal. 1–9. <https://doi.org/10.3390/pharmaceutics12030266>.
- Mazzanti, V., Malagutti, L. dan Mollica, F. (2019) "FDM 3D printing of polymers containing natural fillers: A review of their mechanical properties," *Polymers*, 11(7). <https://doi.org/10.3390/polym11071094>.
- McLouth, T.D., Severino, J. V., Adams, P.M., Patel, D.N. dan Zaldivar, R.J. (2017) "The impact of print orientation and raster pattern on fracture toughness in additively manufactured ABS," *Additive Manufacturing*, 18, hal. 103–109.
<https://doi.org/10.1016/j.addma.2017.09.003>.
- Milenkovic, S., Slavkovic, V., Fragassa, C., Grujovic, N., Palic, N. dan Zivic, F. (2021) "Effect of the raster orientation on strength of the continuous fiber reinforced PVDF/PLA composites, fabricated by hand-layup and fused deposition modeling," *Composite Structures*, 270(February), hal. 114063.
<https://doi.org/10.1016/j.compstruct.2021.114063>.
- Mirzaali, M.J., Pahlavani, H., Yarali, E. dan Zadpoor, A.A. (2020) "Non-affinity in multi-material mechanical metamaterials," *Scientific Reports*, 10(1), hal. 1–10.
<https://doi.org/10.1038/s41598-020-67984-6>.
- Mohamed, O.A., Masood, S.H., Bhowmik, J.L. dan Somers, A.E. (2017) "Investigation on the tribological behavior and wear mechanism of parts processed by fused deposition additive manufacturing process," *Journal of Manufacturing Processes*, 29, hal. 149–159. <https://doi.org/10.1016/j.jmapro.2017.07.019>.
- Mohamed, O.A., Masood, S.H. dan Bhowmik, J.L. (2015) "Optimization of fused

- deposition modeling process parameters: a review of current research and future prospects,” *Advances in Manufacturing*, 3(1), hal. 42–53.
<https://doi.org/10.1007/s40436-014-0097-7>.
- Moritzer, E. dan Wächter, J. (2022) “Development of a Procedure for the Assessment of Material Potentials Under Consideration of the Weld Seam Quality for Multi-material Applications in the FDM Process,” *Macromolecular Symposia*, 404(1), hal. 2100389. <https://doi.org/10.1002/masy.202100389>.
- Mundada, P.S., Yang, C. dan Chen, R.K. (2022) “Investigation of the effects of a pre-deposition heating system on the interfacial temperature and interlayer bonding strength for fused filament fabrication,” (May). <https://doi.org/10.1108/RPJ-02-2021-0033>.
- Muñoz, J. dan Pumera, M. (2020) “3D-printed biosensors for electrochemical and optical applications,” *TrAC Trends in Analytical Chemistry*, 128, hal. 115933. <https://doi.org/10.1016/j.trac.2020.115933>.
- Musa, L., Krishna, N., Zamree, S., Rahim, A., Syahmie, M., Rasidi, M., Edward, A., Rennie, W., Rahman, R., Yousefi, A. dan Azrem, A. (2022) “A review on the potential of polylactic acid based thermoplastic elastomer as filament material for fused deposition modelling,” *Journal of Materials Research and Technology*, 20, hal. 2841–2858. <https://doi.org/10.1016/j.jmrt.2022.08.057>.
- Mustapha, K.B. dan Metwalli, K.M. (2021) “A review of fused deposition modelling for 3D printing of smart polymeric materials and composites,” *European Polymer Journal*, 156(February), hal. 110591. <https://doi.org/10.1016/j.eurpolymj.2021.110591>.
- Nazemidashtarjandi, S., Mousavi, S.A. dan Bastani, D. (2017) “Preparation and characterization of polycarbonate/thermoplastic polyurethane blend membranes for wastewater filtration,” *Journal of Water Process Engineering*, 16, hal. 170–182. <https://doi.org/10.1016/j.jwpe.2017.01.004>.
- Ng, N.Y.Z., Abdul Haq, R.H., Marwah, O.M.F., Ho, F.H. dan Adzila, S. (2022) “Optimization of polyvinyl alcohol (PVA) support parameters for fused deposition modelling (FDM) by using design of experiments (DOE),” *Materials Today: Proceedings*, 57, hal. 1226–1234. <https://doi.org/10.1016/j.matpr.2021.11.046>.
- Nofar, M., Mohammadi, M. dan Carreau, P.J. (2020) “Effect of TPU hard segment content on the rheological and mechanical properties of PLA/TPU blends,”

<https://doi.org/10.1002/app.49387>.

Noor, A., Ahmad, I., Anuar, F.H. dan Abdullah, I. (2016) “Mechanical and thermal properties of natural rubber-modified poly (lactic acid) compatibilized with telechelic liquid natural rubber,” 54, hal. 196–202.

<https://doi.org/10.1016/j.polymertesting.2016.07.021>.

Patil, A., Patel, A. dan Purohit, R. (2017) “An overview of Polymeric Materials for Automotive Applications,” *Materials Today: Proceedings*, 4(2), hal. 3807–3815.

<https://doi.org/10.1016/j.matpr.2017.02.278>.

Pinho, A.C. dan Piedade, A.P. (2021) “Sandwich multi-material 3d-printed polymers: Influence of aging on the impact and flexure resistances,” *Polymers*, 13(22).

<https://doi.org/10.3390/polym13224030>.

Pratama, J., Cahyono, S.I., Suyitno, S., Muflikhun, M.A., Salim, U.A., Mahardika, M. dan Arifvianto, B. (2021) “A review on reinforcement methods for polymeric materials processed using fused filament fabrication (Fff),” *Polymers*, 13(22), hal. 1–23.

<https://doi.org/10.3390/polym13224022>.

Putra, N.E., Mirzaali, M.J., Apachitei, I., Zhou, J. dan Zadpoor, A.A. (2020) “Multi-material additive manufacturing technologies for Ti-, Mg-, and Fe-based biomaterials for bone substitution,” *Acta Biomaterialia*, 109, hal. 1–20.

<https://doi.org/10.1016/j.actbio.2020.03.037>.

Rafiee, M., Farahani, R.D. dan Therriault, D. (2020) “Multi-Material 3D and 4D Printing: A Survey,” *Advanced Science*, 7(12), hal. 1902307.

<https://doi.org/10.1002/advs.201902307>.

Rajpurohit, S.R. dan Dave, H.K. (2018) “Flexural strength of fused filament fabricated (FFF) PLA parts on an open-source 3D printer,” *Advances in Manufacturing*, 6(4), hal. 430–441. <https://doi.org/10.1007/s40436-018-0237-6>.

Ravi, P., Shiakolas, P.S. dan Thorat, A.D. (2017) “Analyzing the Effects of Temperature, Nozzle-Bed Distance, and Their Interactions on the Width of Fused Deposition Modeled Struts Using Statistical Techniques Toward Precision Scaffold Fabrication,” *Journal of Manufacturing Science and Engineering, Transactions of the ASME*, 139(7), hal. 1–9. <https://doi.org/10.1115/1.4035963>.

Redaelli, D.F., Abbate, V., Storm, F.A., Ronca, A., Sorrentino, A., De Capitani, C., Biffi, E., Ambrosio, L., Colombo, G. dan Frascini, P. (2020) “3D printing orthopedic scoliosis braces: a test comparing FDM with thermoforming,”

- Ribeiro, M., Sousa Carneiro, O. dan Ferreira da Silva, A. (2019) “Interface geometries in 3D multi-material prints by fused filament fabrication,” *Rapid Prototyping Journal*, 25(1), hal. 38–46. <https://doi.org/10.1108/RPJ-05-2017-0107>.
- Rodríguez-Parada, L., De La Rosa, S. dan Mayuet, P.F. (2021) “Influence of 3D-printed TPU properties for the design of elastic products,” *Polymers*, 13(15). <https://doi.org/10.3390/polym13152519>.
- Romero, P.E., Arribas-Barrios, J., Rodriguez-Alabanda, O., González-Merino, R. dan Guerrero-Vaca, G. (2021) “Manufacture of polyurethane foam parts for automotive industry using FDM 3D printed molds,” *CIRP Journal of Manufacturing Science and Technology*, 32, hal. 396–404. <https://doi.org/10.1016/j.cirpj.2021.01.019>.
- Sanchez Ramirez, A., Islán Marcos, M.E., Blaya Haro, F., D’Amato, R., Sant, R. dan Porras, J. (2019) “Application of FDM technology to reduce aerodynamic drag,” *Rapid Prototyping Journal*, 25(4), hal. 781–791. <https://doi.org/10.1108/RPJ-09-2018-0251>.
- Schweiger, J., Edelhoff, D. dan Güth, J.F. (2021) “3d printing in digital prosthetic dentistry: An overview of recent developments in additive manufacturing,” *Journal of Clinical Medicine*, 10(9). <https://doi.org/10.3390/jcm10092010>.
- Sharma, A., Chhabra, D., Sahdev, R., Kaushik, A. dan Punia, U. (2022) “Investigation of wear rate of FDM printed TPU, ASA and multi-material parts using heuristic GANN tool,” *Materials Today: Proceedings*, 63, hal. 559–565. <https://doi.org/10.1016/j.matpr.2022.04.015>.
- Shenzhen Esun Industrial Co., L. (2018) *eBOX User Manual Guide*. Wuhan. Tersedia pada: <https://www.esun3d.com/ebox-product/>.
- Shenzhen Esun Industrial Co., L. (2021a) *eFlex (TPU-87A) Technical Data Sheet, Materials Technical Data Sheet*. Tersedia pada: <https://www.esun3d.com/eflex-tpu-87a-product/>.
- Shenzhen Esun Industrial Co., L. (2021b) *PLA+ Technical Data Sheet, Materials Technical Data Sheet*. Tersedia pada: https://www.esun3d.com/uploads/eSUN_PLA+-Filament_TDS_V4.0.pdf.
- da Silva, L.F.M., Öchsner, A. dan Adams, R.D. (2018) *Handbook of Adhesion Technology, Handbook of Adhesion Technology: Second Edition*. Diedit oleh

L.F.M. da Silva, A. Öchsner, dan R.D. Adams. Cham: Springer International Publishing. <https://doi.org/10.1007/978-3-319-55411-2>.

Singh, R., Kumar, R., Farina, I., Colangelo, F., Feo, L. dan Fraternali, F. (2019a)

“Multi-material additive manufacturing of sustainable innovative materials and structures,” *Polymers*, 11(1), hal. 1–14. <https://doi.org/10.3390/polym11010062>.

Singh, S., Singh, N., Gupta, M., Prakash, C. dan Singh, R. (2019b) “Mechanical feasibility of ABS/HIPS-based multi-material structures primed by low-cost polymer printer,” *Rapid Prototyping Journal*, 25(1), hal. 152–161. <https://doi.org/10.1108/RPJ-01-2018-0028>.

Singh, S., Singh, G., Prakash, C. dan Ramakrishna, S. (2020) “Current status and future directions of fused filament fabrication,” *Journal of Manufacturing Processes*, 55(January), hal. 288–306. <https://doi.org/10.1016/j.jmapro.2020.04.049>.

Song, H., Martínez, J., Bedell, P., Vennin, N. dan Lefebvre, S. (2019) “Colored Fused Filament Fabrication,” *ACM Transactions on Graphics*, 38(5), hal. 1–11. <https://doi.org/10.1145/3183793>.

Sorimpuk, N.P., Choong, W.H. dan Chua, B.L. (2022) “Thermoforming Characteristics of PLA/TPU Multi-Material Specimens Fabricated with Fused Deposition Modelling under Different Temperatures,” *Polymers*, 14(20). <https://doi.org/10.3390/polym14204304>.

Syrlybayev, D., Zharylkassyn, B., Seisekulova, A., Akhmetov, M., Perveen, A. dan Talamona, D. (2021) “Optimisation of strength properties of FDM printed parts—A critical review,” *Polymers*, 13(10). <https://doi.org/10.3390/polym13101587>.

Tabuani, D., Bellucci, F., Terenzi, A. dan Camino, G. (2012) “Flame retarded Thermoplastic Polyurethane (TPU) for cable jacketing application,” *Polymer Degradation and Stability*, 97(12), hal. 2594–2601. <https://doi.org/10.1016/j.polymdegradstab.2012.07.011>.

Tamburrino, F., Graziosi, S. dan Bordegoni, M. (2019) “The influence of slicing parameters on the multi-material adhesion mechanisms of FDM printed parts: an exploratory study,” *Virtual and Physical Prototyping*, 14(4), hal. 316–332. <https://doi.org/10.1080/17452759.2019.1607758>.

Tao, Y., Kong, F., Li, Z., Zhang, J., Zhao, X., Yin, Q., Xing, D. dan Li, P. (2021) “A review on voids of 3D printed parts by fused filament fabrication,” *Journal of Materials Research and Technology*, 15, hal. 4860–4879. <https://doi.org/10.1016/j.jmrt.2021.10.108>.

- Terekhina, S., Skorniyakov, I., Tarasova, T. dan Egorov, S. (2019) "Effects of the Infill Density on the Mechanical Properties of Nylon Specimens Made by Filament Fused Fabrication," *Technologies*, 7(3), hal. 57.
<https://doi.org/10.3390/technologies7030057>.
- Teresa Rodríguez-Hernández, M., Angulo-Sánchez, J.L. dan Pérez-Chantaco, A. (2007) "Determination of the molecular characteristics of commercial polyethylenes with different architectures and the relation with the melt flow index," *Journal of Applied Polymer Science*, 104(3), hal. 1572–1578.
<https://doi.org/10.1002/app.25625>.
- Tezel, T. (2021) "The effect of machining parameters on the surface quality of 3D printed and cast polyamide," *Machining Science and Technology*, 25(5), hal. 703–720. <https://doi.org/10.1080/10910344.2021.1971704>.
- Troughton, M.J. (ed.) (2009) "Adhesive Bonding," in *Handbook of Plastics Joining*. Second Edi. Boston: Elsevier, hal. 145–173. <https://doi.org/10.1016/B978-0-8155-1581-4.50019-6>.
- Valerga, A.P., Batista, M., Salguero, J. dan Girot, F. (2018) "Influence of PLA filament conditions on characteristics of FDM parts," *Materials*, 11(8).
<https://doi.org/10.3390/ma11081322>.
- Vanderploeg, A., Lee, S.E. dan Mamp, M. (2017) "The application of 3D printing technology in the fashion industry," *International Journal of Fashion Design, Technology and Education*, 10(2), hal. 170–179.
<https://doi.org/10.1080/17543266.2016.1223355>.
- Venumbaka, S.A., Covarubias, M., Cesaro, G., Ronca, A., De Capitani, C., Ambrosio, L. dan Sorrentino, A. (2020) "Application of Multi Materials Additive Manufacturing Technique in the Design and Manufacturing of Hand Orthoses," in K. Miesenberger et al. (ed.) *Computers Helping People with Special Needs*. Cham: Springer International Publishing, hal. 461–468.
- Vyavahare, S., Teraiya, S., Panghal, D. dan Kumar, S. (2020) "Fused deposition modelling: a review," *Rapid Prototyping Journal*, 26(1), hal. 176–201.
<https://doi.org/10.1108/RPJ-04-2019-0106>.
- Waly, C., Petersmann, S. dan Arbeiter, F. (2022) "Multimaterial Extrusion-Based Additive Manufacturing of Compliant Crack Arrestor: Influence of Interlayer Length, Thickness, and Applied Strain Rate," *Advanced Engineering Materials*, 2101703, hal. 1–11. <https://doi.org/10.1002/adem.202101703>.

- Wang, F., Ji, Y., Chen, C., Zhang, G. dan Chen, Z. (2022) "Tensile properties of 3D printed structures of polylactide with thermoplastic polyurethane," *Journal of Polymer Research*, 29(8), hal. 320. <https://doi.org/10.1007/s10965-022-03172-6>.
- Wang, J., Goyanes, A., Gaisford, S. dan Basit, A.W. (2016) "Stereolithographic (SLA) 3D printing of oral modified-release dosage forms," *International Journal of Pharmaceutics*, 503(1–2), hal. 207–212. <https://doi.org/10.1016/j.ijpharm.2016.03.016>.
- Wang, P., ZOU, B., DING, S., LI, L. dan HUANG, C. (2021) "Effects of FDM-3D printing parameters on mechanical properties and microstructure of CF/PEEK and GF/PEEK," *Chinese Journal of Aeronautics*, 34(9), hal. 236–246. <https://doi.org/10.1016/j.cja.2020.05.040>.
- Wang, X., Zhao, L., Fuh, J.Y.H. dan Lee, H.P. (2019) "Effect of porosity on mechanical properties of 3D printed polymers: Experiments and micromechanical modeling based on X-ray computed tomography analysis," *Polymers*, 11(7). <https://doi.org/10.3390/polym11071154>.
- Watschke, H., Waalkes, L., Schumacher, C. dan Vietor, T. (2018) "Development of Novel Test Specimens for Characterization of Multi-Material Parts Manufactured by Material Extrusion," *Applied Sciences*, 8(8), hal. 1220. <https://doi.org/10.3390/app8081220>.
- Xu, Z., Ha, C.S., Kadam, R., Lindahl, J., Kim, S., Wu, H.F., Kunc, V. dan Zheng, X. (2020) "Additive manufacturing of two-phase lightweight, stiff and high damping carbon fiber reinforced polymer microlattices," *Additive Manufacturing*, 32(January), hal. 101106. <https://doi.org/10.1016/j.addma.2020.101106>.
- Yavas, D., Liu, Q., Zhang, Z. dan Wu, D. (2022) "Design and fabrication of architected multi-material lattices with tunable stiffness, strength, and energy absorption," *Materials and Design*, 217, hal. 110613. <https://doi.org/10.1016/j.matdes.2022.110613>.
- Yin, J., Lu, C., Fu, J., Huang, Y. dan Zheng, Y. (2018) "Interfacial bonding during multi-material fused deposition modeling (FDM) process due to inter-molecular diffusion," *Materials and Design*, 150, hal. 104–112. <https://doi.org/10.1016/j.matdes.2018.04.029>.
- Zagidullin, R.S., Zezin, N.I. dan Rodionov, N. V. (2021) "Improving the quality of FDM 3D printing of UAV and aircraft parts and assemblies by parametric software changes," *IOP Conference Series: Materials Science and Engineering*,

1027(1). <https://doi.org/10.1088/1757-899X/1027/1/012031>.

- Zhang, H., Ke, F., Shao, J., Wang, C., Wang, H. dan Chen, Y. (2022) “One-step fabrication of highly sensitive pressure sensor by all FDM printing,” *Composites Science and Technology*, 226(December 2021), hal. 109531.
<https://doi.org/10.1016/j.compscitech.2022.109531>.
- Zhang, Y.-F., Zhang, N., Hingorani, H., Ding, N., Wang, D., Yuan, C., Zhang, B., Gu, G. dan Ge, Q. (2019) “Fast-Response, Stiffness-Tunable Soft Actuator by Hybrid Multimaterial 3D Printing,” *Advanced Functional Materials*, 29(15), hal. 1806698. <https://doi.org/10.1002/adfm.201806698>.
- Zhao, C., Ruan, S., Wang, J. dan Su, Y. (2020a) “Application and Surface Characterization of Braille Production Based on FDM 3D Printing,” in P. Zhao et al. (ed.) *Advanced Graphic Communication, Printing and Packaging Technology*. Singapore: Springer Singapore, hal. 370–373.
- Zhao, X., Shou, T., Liang, R., Hu, S., Yu, P. dan Zhang, L. (2020b) “Bio-based thermoplastic polyurethane derived from polylactic acid with high-damping performance,” *Industrial Crops and Products*, 154(15), hal. 112619.
<https://doi.org/10.1016/j.indcrop.2020.112619>.
- Zhejiang Flashforge 3D Technology Co., L. (2016) *FlashForge Inventor 3D Printer User Guide*.