UNIVERSITAS
GADJAH MADA
PENGEMBANGAN CARBONIZED POLYMER DOTS (CPDs) SEBAGAI MATERIAL BERFLUORESENSI BERBASIS LIMBAH POLIETILEN TEREFTALAT (PET) MELALUI KALSINASI KERING DAN BASAH
RIDHO KURNIAWAN, Dr.Eng. Ahmad Kusumaatmaja, S.Si., M.Sc.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

INTISARI

PENGEMBANGAN *CARBONIZED POLYMER DOT* (CPDS) SEBAGAI MATERIAL BERFLUORESENSI BERBASIS LIMBAH POLIETILEN TEREFTALAT (PET) MELALUI KALSINASI KERING DAN BASAH

RIDHO KURNIAWAN
24/547700/PPA/06905

Limbah polietilen tereftalat (PET) berpotensi dimanfaatkan sebagai prekursor material luminesen berbasis *carbonized polymer dots* (CPDs). Penelitian ini mengkaji pengaruh koprekursor dan jalur kalsinasi kering–basah terhadap fotoluminesensi, heterogenitas material padat, dan kecenderungan *quenching*. PET dikombinasikan dengan asam sitrat (CA) atau L-glutamat (LGA), serta p-fenilendiamina (pPDA) atau m-fenilendiamina (mPDA), kemudian dipanaskan dalam autoklaf berlapis Teflon pada 180 °C selama 5 jam, tanpa air untuk jalur kering dan dengan air untuk jalur basah. Produk dikarakterisasi menggunakan UV–Vis, PL/PLE, *PL mapping*, FTIR, Raman, SEM/EDX, dan TG/DTA.

Hasil PL/PLE sampel *wet* menunjukkan bahwa sistem *pPDA* menghasilkan dua kanal eksitasi–emisi, sedangkan sistem *mPDA* menghasilkan tiga kanal, dengan kanal terpanjang pada *LGA-mPDA wet* pada pasangan $\lambda_{ex}/\lambda_{em}$583/608 nm. Pada sistem *CA-pPDA*, sampel *wet* menunjukkan heterogenitas keadaan optik relatif dan morfologi padatan yang lebih tinggi dibandingkan sampel *dry*, didukung oleh analisis *Urbach-like*, *PL mapping*, FTIR, Raman, dan SEM/EDX. Kedua jalur tetap menghasilkan emisi PL pada fase padat, tetapi sampel *dry* cenderung mempertahankan fraksi luminesen dalam padatan, sedangkan sampel *wet* menghasilkan fraksi luminesen yang lebih mudah diakses etanol namun lebih heterogen pada fase padat. Dengan demikian, limbah PET berhasil ditransformasi menjadi material *CPDs/CPDs-like* heterogen, dengan koprekursor menentukan kanal emisi dan keberadaan air memengaruhi heterogenitas serta kecenderungan *quenching*.

Kata kunci: limbah PET, *carbonized polymer dots*, fotoluminesensi, kalsinasi kering–basah, *quenching*.

UNIVERSITAS
GADJAH MADA
PENGEMBANGAN CARBONIZED POLYMER DOTS (CPDs) SEBAGAI MATERIAL BERFLUORESENSI BERBASIS LIMBAH
POLIETILEN TEREFTALAT (PET) MELALUI KALSINASI KERING DAN BASAH
RIDHO KURNIAWAN, Dr.Eng. Ahmad Kusumaatmaja, S.Si., M.Sc.
Universitas Gadjah Mada, 2026 | Diunduh dari http://etd.repository.ugm.ac.id/

ABSTRACT

DEVELOPMENT OF CARBONIZED POLYMER DOT (CPDs) AS THE FLUORESCENT MATERIALS BASED ON POLYETHILENE TEREPHTALATE (PET) WASTES THROUGH DRY AND WET CALCINATION METHOD

RIDHO KURNIAWAN
24/547700/PPA/06905

Polyethylene terephthalate (PET) waste has potential as a precursor for luminescent materials based on carbonized polymer dots (CPDs). This study investigated the effects of co-precursors and dry–wet calcination routes on the photoluminescence, solid-state heterogeneity, and quenching tendency of PET-based luminescent materials. PET was combined with citric acid (CA) or L-glutamate (LGA), and with p-phenylenediamine (pPDA) or m-phenylenediamine (mPDA), followed by heating in a Teflon-lined autoclave at 180 °C for 5 h. The dry route was conducted without added water, whereas the wet route used water as the reaction medium. The products were characterized using UV–Vis, PL/PLE, PL mapping, FTIR, Raman, SEM/EDX, and TG/DTA analyses.

The PL/PLE results of the *wet* samples showed that the pPDA-based systems exhibited two excitation–emission channels, whereas the mPDA-based systems exhibited three channels, with the longest-wavelength channel observed in LGA-mPDA *wet* at a $\lambda_{ex}/\lambda_{em}$pair of 583/608 nm. In the CA-pPDA system, the *wet* sample exhibited greater relative optical-state heterogeneity and solid-state morphological heterogeneity than the *dry* sample, as supported by *Urbach-like* analysis, PL mapping, FTIR, Raman, and SEM/EDX. Both routes produced materials that remained luminescent in the solid state; however, the *dry* samples tended to retain the luminescent fraction within the solid matrix, whereas the *wet* samples produced luminescent fractions that were more accessible to ethanol but more heterogeneous in the solid state. Therefore, PET waste was successfully transformed into heterogeneous CPDs/CPDs-like luminescent materials, in which the co-precursors determined the emission channels, while the presence of water influenced heterogeneity and quenching tendency.

Keywords: PET waste, carbonized polymer dots, photoluminescence, dry–wet calcination, quenching.