EFFECT OF ELECTRON-ATTRACTING GROUPS ON THE THERMAL STABILITY OF SUBSTITUTED COPPER(II) BENZOATE

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ABSTRACT

Copper(II) benzoate, copper(II) 4-fluorobenzoate, copper(II) 4-chlorobenzoate, copper(II) 4-bromobenzoate, copper(II) 4-iodobenzoate, copper(II) pentafluorobenzoate, copper(II) 4-nitrobenzoate and copper(II) 3,5-dinitrobenzoate are potential low dimensional thermally stable molecular electronics. The thermal properties of these samples are investigated by thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC).

TGA reveals that copper(II) benzoate (CB) slowly decomposed at 243.5 °C, losing 67.7 % of its weight at 515 °C. The DSC shows two endotherms separated by an exotherm. The first endotherm at 224 °C may due to the breaking of bridging bond to give benzoyloxy radicals. The exotherm at 231 °C may due to the formation of volatiles from the decomposition of benzoyloxy radical formed. The final endotherm at 278 °C may be due to the breaking of copper-copper bond before the material decomposed completely to compounds of copper(II) such as copper(II) oxide.

Derivatives of CB containing electron-attracting groups, namely fluoro, chloro, bromo, iodo, pentafluoro, nitro and dinitro have higher decomposition temperatures than CB, ranging from 313 °C to 334 °C. The dinitro derivative is the most thermally stable while the pentafluoro derivative is the least. The decomposition pattern of the derivatives are similar to CB, and may be similarly explained.

ABSTRAK

Kuprum(II) benzoat, kuprum(II) 4-fluorobenzoat, kuprum(II) 4-klorobenzoat, kuprum(II) 4-bromobenzoat, kuprum(II) 4-iodobenzoat, kuprum(II) pentafluorobenzoat, kuprum(II) 4-nitrobenzoat and kuprum(II) 3,5-dinitrobenzoat adalah berpotensi sebagai molekul elektronik berdimensi rendah. Sifat-sifat terma sampel-sampel tersebut dianalisis dengan menggunakan analisis termogravimetri (TGA) dan kalorimetri imbasan pembeza (DSC).

Analisis TGA menunjukkan bahawa kuprum(II) benzoat terurai secara perlahan pada suhu 243.5 °C dengan kehilangan 67.7 % daripada jumlah beratnya pada suhu 515 °C. Graf DSC menunjukkan terdapat dua puncak endotherm yang dipisahkan oleh satu puncak eksoterm. Endoterm pertama yang berlaku pada suhu 278 °C mungkin disebabkan oleh pemutusan ikatan titian yang menghasilkan radikal benzoiloksi. Eksoterm pada suhu 231 °C mungkin disebabkan oleh pembentukan molekul mudah meruap akibat daripada proses penguraian radikal benzoiloksi. Endoterm yang terakhir pada 278 °C mungkin akibat pemutusan ikatan kuprum-kuprum sebelum bahan tersebut terurai sepenuhnya kepada sebatian-sebatian kuprum(II) seperti kuprum(II) oksida.

Terbitan kuprum(II) benzoat yang mengandungi kumpulan penarik elektron, iaitu fluoro, kloro, bromo, iodo, pentafluoro, nitro dan dinitro mempunyai suhu penguraian yang lebih tinggi dari kuprum(II) benzoat, iaitu pada julat 313 °C hingga 334 °C. Terbitan dinitro adalah paling stabil sementara terbitan pentafluoro adalah paling tidak stabil. Polar penguraian bagi terbitan kuprum(II) benzoat adalah serupa seperti kuprum(II) benzoat dan dapat dijelaskan dengan cara yang serupa.

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