# CuO/PMMA polymer nanocomposites as resist materials for e-beam lithography

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Polymer nanocomposites, defined as polymers containing fillers with at least one dimension smaller than 100nm at very low loadings (<5 vol. %), have emerged as a new powerful class of materials for a wide range of applications. An important application is their use as the functional core of novel micro/nano-electronic devices [1]. Towards that goal, intense research effort has been focusing on the successful incorporation of nano-sized fillers into polymers with particular emphasis being given into developing them as new resist materials for Electron Beam Lithography (EBL) [2]. A major bottleneck in this pursuit has been the low miscibility of the inorganic nanofillers within the polymer matrix and their tendency to form agglomerates and aggregates.

This work has concentrated on devising a relatively facile and cost-efficient approach for the creation of CuO/PMMA nanocomposites as a novel EBL resist material. The CuO nanofillers have been synthesized via a low-cost solution-based method, which offers a high degree of design versatility through simple key parameters, such as the temperature and the precursor concentration. While grafting has been the most common method to enhance the nanofiller miscibility, the present approach entailed the use of polar solvents and physical mixing so as to keep the cost and preparation time as low as possible [3]. The produced nanocomposites were evaluated as positive tone EBL resists with respect to various parameters, such as the nature of the solvent, the nanofiller loading, spin-coating conditions and the employment of deflocculant. The studies were complemented by micro-X-ray fluorescence spectroscopy (μXRF), which was employed –for the first time to our knowledge- to investigate the miscibility of the nanofillers within the polymer matrix. The results show that despite its simplicity the suggested method can yield positive tone CuO/PMMA EBL resists.

References:

1. L. S. Schadler, L. C. Brinso & W. G. Sawyer, *JOM* **59**, 53 (2007)
2. L. Merhari et al., *Microelectronics Engin.* 63, 391–403 (2002)
3. S. Botsi et al., *Nano-Structures & Nano-Objects* **17**, 7 (2019)