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Copper nanoparticles synthesized in polymers by ion implantation: Surface morphology and optical properties of the nanocomposites

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Abstract

Copyright © Materials Research Society 2014. Polymethylmethacrylate (PMMA) and polyimide (PI) samples are implanted by 40 keV Cu+ ions with high fluences to synthesize copper nanoparticles in shallow polymer layers. The produced metal/polymer nanocomposites are studied using atomic force and scanning electron microscopies as well as optical transmission spectroscopy. It is found that nucleation and growth of copper nanoparticles are strongly fluence-dependent as well as they are affected by the polymer properties, in particular, by radiation stability yielding different nanostructures for the implanted PI and PMMA. Shallow synthesized nanoparticles are observed to partly tower above the sample surface due to a side effect of high-fluence irradiation leading to considerable sputtering of polymers. Implantation and particle formation significantly change optical properties of both polymers reducing transmittance in the UV-visible range due to structural and compositional change as well as causing an absorption band related to localized surface plasmon resonance (LSPR) of the nanoparticles. The role of polymer type and its degradation under the implantation on LSPR is studied to optimize conditions for the formation of nanoplasmonic materials.

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