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Synthesis of Copper Oxide Nanoparticles by Reactive Magnetron Sputtering

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Gas aggregation cluster source (GAS) is an attractive plasma-based instrument for the preparation of nanoparticles (NPs) including those of metals and plasma polymers. Although the synthesis of metal oxide NPs was also demonstrated, the examples are really scarce. In this work, we used a magnetron-based GAS for the synthesis of copper oxide NPs which can be beneficial as catalytic, optically active and bactericidal agents. Reactive DC magnetron sputtering of Cu target in Ar/O_2 mixtures of different composition was investigated to achieve the stable production of the copper oxide NPs. It was found that 7 vol. % of O_2 is the optimal value in terms of the deposition rate. The post-oxidation SEM analysis showed the decrease of the NP mean size from 21 nm to 12 nm as compared to Cu NPs, and the HR-TEM analysis demonstrated that the NPs are crystalline. The formation of the oxide was confirmed by a 15 % increase of the oxygen content determined by XPS as well as by a significant shift of the Cu 2p XPS peak to higher binding energy with reference to metallic Cu NPs. The analysis also showed that the surface stoichiometry correspond to Cu (II) oxide. The UV-Vis measurements confirmed the formation of copper oxide by the loss of the plasmon resonance peak at 560 nm which was observed for metallic Cu NPs.
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