Influence of reactive gases on the nucleation and growth of Ag nanoparticles in gas-phase synthesis

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Nowadays, metal nanoparticles are widely studied for their exceptional physicochemical properties (plasmonic, catalytic, *etc.*) and exploited for various applications. In particular, silver nanoparticles (AgNPs) possess remarkable antibacterial properties which come from the release of Ag^+ ions, and which are frequently used for bio-medical applications.

Our goal is to develop new "nano-safer by design" systems, based on AgNPs embedded in dielectric matrices, in order to provide a locally controlled Ag^+ release, and thus an antimicrobial activity over an adjustable period of time (from few days up to a few months) while limiting environmental risks related to the toxicity of AgNPs [1]. In this work, AgNPs are synthesized in vapor phase by magnetron sputtering [2] and size-selected by a quadrupole mass filter, before being deposited on a substrate. This original fabrication technique allows to independently control the AgNPs density and size distribution (in the 0.5-15 nm range), by varying the synthesis conditions. In order to improve the process efficiency, the nucleation rate has to be maximized by adjusting the deposition parameters.

Here we will focus on the effects of different reactive gases introduced into the aggregation chamber on the nucleation and growth of AgNPs. The structural properties of the obtained nanoparticles (size, density, crystalline structure and morphology) are studied by transmission electron microscopy techniques down to the atomic scale and correlated with the synthesis parameters. The possible nucleation and growth mechanisms involved will be discussed.

[1] A. Pugliara, K. Makasheva, B. Despax, M. Bayle, R. Carles, P. Benzo, G. BenAssayag, B. Pécassou, M. C. Sancho, E. Navarro et al., *Sci. Total Environ.* 2016, 565, 863-871

[2] *Gas-Phase Synthesis of Nanoparticles*; Y. Huttel, Ed.; Wiley-VCH, 2017.