

Design of bioactive Ag-Nanocomposites with a single-step plasma process

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Producing materials that are efficient for reducing and killing bacteria and harmless for humans and the environment is still a big challenge in research and science. Different materials are under investigation, including silver. Ag is proven to be effective against several bacteria strains^[1] and does not promote bacterial resistance. Plasma-deposited nanocomposites enable products with very low raw material input.

The combination of plasma polymerization and etching within a co-sputtering process was found to result in the incorporation of metal nanoparticles^[2] in a hydrocarbon matrix. In addition, the plasma polymer matrix can be designed in a way that accessible functional groups are exposed within a nanoporous structure. These structures possess a high specific surface area and may thus provide a high density of functional groups^[3]. The deposition of nanostructured coatings depends on reactor design parameters and operating conditions such as power input, gas flow, and gas composition.

A capacitively coupled radiofrequency batch reactor (asymmetric geometry) was used to produce the multifunctional coatings in a one-step process. The polymer matrix is built-up by using ethylene (C₂H₄) as a monomer gas. In addition, carbon dioxide (CO₂) is used as the reactive gas in order to structure the matrix and add functional groups to the a-C:H network^[4]. An excess of argon is used in the gas mixture for co-sputtering from a Ag cathode.

The size and the growing behavior of the Ag nanoparticles show a clear dependence on the process parameters gas ratio and power input. The particle distribution could be classified in different sections with TEM measurements. The total Ag content in the films is determined with ICP-OES. This method is also used to quantify the Ag release of the nanocomposite coatings. Figure 1 shows that the Ag release (after 14 days) is proportional to the Ag content which is available in the nanocomposite.

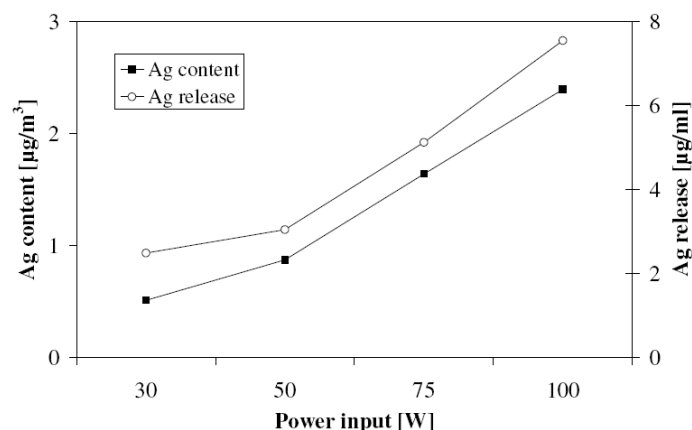


Fig. 1: Dependence of Ag release on the Ag content of Ag/a-C:H:O coatings

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