Deposition of Cu/a-C:H nanocomposite films

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Hard plasma polymer coatings are widely used in many industrial applications due to their superior hardness and tribological properties. Such plasma polymer films have also excellent barrier properties, they are not toxic and they are in general transparent in the range of visible light. This makes them very promising material for food packaging industry. The presented work is focused on the possibility to incorporate copper clusters in to hard a-C:H coatings in order to obtain films with high barrier properties and antibacterial character.

The polymeric matrix was deposited in an Ar/n-hexane mixture. The substrates were placed on a planar electrode connected to the pulsed RF power supply. Effects of the RF power and the duty cycle on the properties of the matrix were studied by means of XPS, optical ellipsometry, UV-Vis spectrophotometry and nanoindentation technique. Cu nanoparticles (NPs) were deposited by means of Haberland type gas aggregation cluster source (GAS) with particle flux perpendicular to the substrates to be coated. Two different strategies for composite films deposition were tested. First, the NPs were deposited at constant conditions in the GAS while RF duty cycle was changed. It was found that in case of constant deposition time total amount of clusters in the film was almost constant while filling factor changed because of different deposition rate of aC:H matrix. In the second case, the deposition rate of Cu NPs was varied by magnetron current in the GAS while the parameters for matrix deposition were kept constant. In this case both, total amount of Cu NPs and filling factor changed. In both cases were Cu NPs embedded in the a-C:H matrix and such a films exhibit anomalous absorption around 600 nm and presence of even small amount of Cu NPs leads to the change of the mechanical properties of the films.

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