POLYMER-BASED NUCLEATION FOR DIAMOND CVD GROWTH

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Abstract

Diamond has outstanding properties which make it a promising material for a wide variety of applications. However, the synthesis of homogeneous large area films on non-diamond surfaces is still a challenge. The material of the substrate and its surface pre-treatment (nucleation) strongly influence the properties of the resulting film.

In this study, we present polymer-based carbon as the nucleation layer for diamond deposition. Two types of polymers were used: polylactic-co-glycolic acid (PLGA) and polyvinyl alcohol (PVA). Both polymers were used either as microspheres or thin films (without/with diamond powder-DP). The polymer films were prepared using spin-coating. The diamond CVD growth was performed in a microwave plasma system.

For ultra-thin pure polymer layers and microsphere monolayers we did not observe any diamond growth. However, increasing the polymer thickness (2-3x spin-coating) enhanced the nucleation process. Higher nucleation density was also observed for a combination of polymer microspheres with pure polymer layers. For (ultra-) thin polymer composite layers containing diamond powder, a clear increase of the nucleation densities was achieved. We propose a model in which carbon-based polymers act as the nucleation layer providing an additional source of C atoms which are partially converted into sp3 bonded carbon phase.

This technique allows diamond growth over a large area on a wide range of substrates, including extremely soft or fragile samples, or substrates with complex geometry and shape such as 3D GaN membranes.

Keywords: Diamond nucleation, polymers, PLGA, PVA, microwave plasma

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