

Nanocrystalline Diamond Films based on Detonation Nanodiamonds and Applications

J.E. Butler

*Gas/Surface Dynamics Section, Code 6174, Naval Research Laboratory, Washington DC
20375 USA*

Detonation nanodiamond powders have enabled a major advance in the nucleation and growth of smooth, continuous nanodiamond films and coatings by chemical vapor deposition (CVD). Nucleation seed densities exceeding $10^{12}/\text{cm}^2$ have been achieved and the impact on the resultant CVD films is significant. The resultant CVD diamond films have remarkably high thermal diffusivity, Young's modulus, low surface roughness, negligible sp^2 carbon content, and high optical transparency. The films can be grown between 400 and 900°C, and can be conformal to a variety of substrate topologies and materials. Lithographic patterning and reactive ion etching have been developed to produce device structures with nm critical dimensions. Fully dense films as thin as 30 nm have been grown and fabricated into mechanical resonator structures. Examples of applications to NEMS/MEMS, silicon on insulator wafers, transparent electrochemical electrodes, etc. will be presented.