

Evidence of columnar diamond growth structures within cathode spot craters of vacuum arcs on carbon

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Abstract: Cross-sections of erosion craters formed by vacuum arc discharges on graphite cathodes are examined using electron microscopy. These reveal erosion craters that are covered with a growth layer forming a continuous film on the arced surface. The film surface is composed of sphere-like structures similar to cauliflower diamond and to the emitted macro-particles (MPs) observed in coating experiments using graphite vacuum arc sources. The film thickness within the cathode erosion craters evolves with the mean values of the MP diameter and mean crater depth for four graphite material morphologies. These two parameters increase with a decrease in arc spot velocity. The growth layer shows a relatively porous columnar structure, with micro-Raman spectroscopy indicating an evolution from amorphous carbon (cathode base), to graphitic (middle), to diamond dominating the top layer.