LARGE-AREA MICROWAVE PLASMA DEPOSITION SYSTEM FOR UNCD COATING OF SIC PUMP SEALS

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Abstract

An 11” microwave plasma Ultra-Nano-Crystalline-Diamond (UNCD) deposition system has been commissioned for the production coating of UNCD onto SiC pump seals. This work is presented along with earlier results using a similar 6” reactor where only one 2.0” diameter seal may be grown at a time, while the 11” system allows seven 2.0” diameter seals to be coated simultaneously. Seals are held in the cavities of a heated graphite “muffin tin” susceptor such that the top surface of the seals is even with the graphite presenting a flat planar surface to the plasma. The substrate heater temperature is 800-900°C while the seal growth surface temperature is up to 200°C hotter due to heating by the plasma. The plasma gas composition is primarily Ar with 1-4% CH_4 and 0-5% H_2. The plasma reactor is an 11-pole toroidal resonator cavity surrounding a vertical quartz tube reaction chamber with a aluminum top plate gas distributor. Materials to be coated are introduced into the reaction chamber from a bottom port using a cylindrical vertically-translating heated stage. Seals coated in the 6” system were tested by the manufacturer of the seals, John Crane Inc., with very satisfactory results. Preliminary results in the 11” system have successfully demonstrated growth of UNCD onto a 7-seal arrangement with a center seal and a surrounding second circle of 6 seals. Growth of high temperature UNCD on 200 mm Si wafers has also been demonstrated. The uniformity of the thickness and structural properties of the UNCD films are presented. The results presented here provide valuable information regarding the large-area deposition of UNCD diamond films.