Abstract for submission to
SERMACS 2003
9/10/03

CVD Diamond Stripping Foils for the Spallation Neutron Source

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The Spallation Neutron Source (SNS) is currently under construction at Oak Ridge National Laboratory and due to come on-line in 2006. Neutrons will be produced in this facility by the spallation process, where a 1 GeV H^+ beam will collide with a mercury target to spall off ~ 10 neutrons per incident proton. The H^+ beam will be generated by scattering H^- through a stripping foil to remove two electrons. Stripper foils, typically constructed of thin amorphous carbon films, are widely used in accelerators to produce positively charged beams. However, traditional foils are projected to have a limited (<20 hr) lifetime under the operating conditions of SNS. Chemical vapor deposited (CVD) diamond stripping foils have shown promise of extending foil lifetimes by factors of 10 or more. The design criteria for these films are 1 x 1 cm, 1 micrometer thickness, and mechanically stable when supported on no more than 2 edges (L-bracket support). Fine-grained polycrystalline diamond foils, including nanocrystalline diamond, meeting these criteria have been grown by hot filament and microwave plasma deposition. Essentially flat L-bracket supported foils have been produced by conformal deposition of diamond on corrugated silicon substrates followed by chemical etching of the silicon to yield windows with the desired dimensions. Results of foil lifetime testing and film characterization are compared.

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SNS is managed by UT-Battelle, LLC, under contract DE-AC05-00OR22725 for the U.S. Department of Energy. SNS is a collaboration of six US National Laboratories: Argonne National Laboratory (ANL), Brookhaven National Laboratory (BNL), Thomas Jefferson National Accelerator Facility (TJNAF), Los Alamos National Laboratory (LANL), Lawrence Berkeley National Laboratory (LBNL), and Oak Ridge National Laboratory (ORNL). This research was supported in part by an appointment to the Oak Ridge National Laboratory

Research Participation Program administered jointly by the Oak Ridge Institute for Science and Education and Oak Ridge National Laboratory."