Diamond-like Carbon for Ultra-cold Neutrons

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As a part of the ultra-cold neutron (UCN) source project at the Paul Scherrer Institut (PSI), the performance of diamond-like Carbon (DLC) as a novel material for the storage of UCN was investigated and promising results were obtained. We focus on three important parameters for UCN storage: (i) the Fermi potential V_F, (ii) the loss coefficient per wall collision η, and (iii) the spin flip probability per wall collision β. Contrary to the commonly used material Beryllium, DLC is not toxic and widely used in industry. It combines a low nuclear absorption cross section and a high density, which causes a low loss coefficient, low inelastic scattering and a large Fermi potential. Systematic investigations of different DLC coatings by various surface analysis methods we performed, as well as studies using UCN. We measured values for the loss coefficient of DLC $\eta = (7 \pm 0.9) \cdot 10^{-5}$ at 70 K and a depolarization probability $\beta = (7.5 \pm 2) \cdot 10^{-7}$ which is competitive to Beryllium. Using this experience, a new facility to produce high density DLC coatings is currently being built at PSI.