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Neutron Scattering "Halo" Observed in Highly Oriented Pyrolytic Graphite[1] LILIN HE, WILLIAM HAMILTON, TAO HONG, LOWELL CROW, BAILEY KATHERINE, NIDIA GALLEGO, Oak Ridge National Laboratory — We report the first observation of a "Halo" ring in the small-angle neutron scattering (SANS) region of highly oriented pyrolytic graphite (HOPG). The scattering presents as a ring with a half cone angle ˜12.3, which is nearly independent of the incident wavelength and persists to wavelengths far beyond the Bragg cutoff for graphite (6.71Å). At normal incidence to the honeycomb lattice planes of HOPG the ring is centered about their normal. When the sample is tilted the ring moves in the same direction as the normal. However the shift or the scattering ring is less than the sample tilt and varies with wavelength. The ring broadens and splits into doublets with increasing wavelength. As the ring cone shifts it narrows down on the side of the cone's moving direction while it broadens in the opposite side. Additionally, the ring broadens and weakens with decreasing HOPG quality. We also notice that the peak intensity linearly scales with the sample thickness. Inelastic neutron scattering measurements show the neutrons in the ring have gained a couple of meV. We infer that this "Halo" effect might be induced by the sinusoidally curved surface of crystallites, coupled with low energy phonon scattering. This finding may open a new avenue to guide neutrons by modifying the surface shape of materials.

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