Supporting Materials:

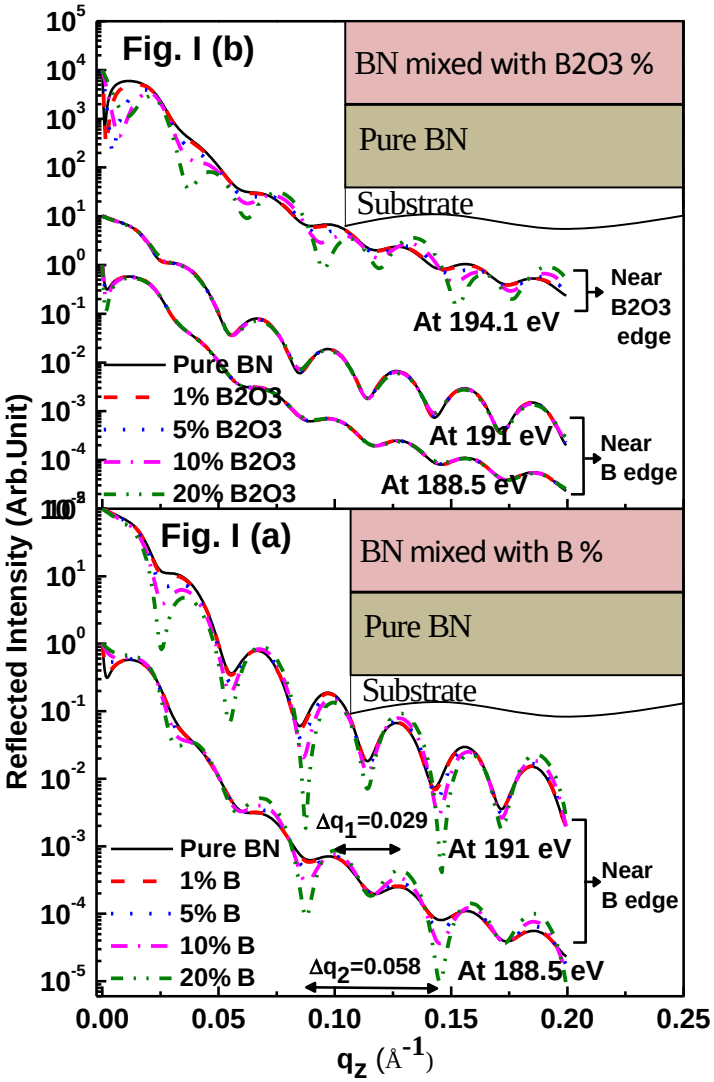

Figure I (For supporting material). Simulated SXRR profiles at selected photon energies near different absorption edges for an ideal (zero roughness) bilayer structure (Mixed BN (11 nm)-on-Pure BN (11 nm)) on Si substrate. The top mixed layer is uniformly mixed with different atomic percentages. (a) Mixing with different B at. % near B edge (b) Mixing with different B_2O_3 at. % near B and B_2O_3 edge.

Fig. I (in supporting material) demonstrates the sensitivity of SXRR to variation in at. % through simulations on an ideal bilayer structure. Fig. I (a) shows variation of simulated spectral features by incorporation of different at. % of resonating B atoms uniformly throughout the top layer near the B edge at two different selected energies. Simulated profile without B mixing (continuous line) shows only a single film modulation in amplitude of oscillations. However, as at. % of B is incorporated at top layer, it changes the amplitude and shape of the oscillations envelope in entire simulated scattered profile. Even by mixing 5 % of B, brings significant change in optical properties of the top layer. This is clearly evidenced from the change in modulation in amplitude of oscillations from single layer to bilayer structure in the scattered profile. Since the thickness of top and bottom layer are same (11nm each), so one modulation having Δq_1=0.029 is exactly half of the second modulation having Δq_1=0.058. The amplitude modulation having Δq_1=0.029 is due to interface of reflected beam from the top of the film and the bottom of second layer giving information about total film thickness (22nm). The amplitude modulation having Δq_2=0.058 is due to interface of reflected beam from the top and the bottom of each layer giving information about thickness of each layer (11nm). Simulated spectral feature undergoes strong variation at 191 compared to 188.5 eV due to large change in optical properties of B as the incident photon energy is tuned to B edge (~189.5 eV). Fig. I (b) shows variation of simulated spectral feature by incorporation of different at. % of B_2O_3 uniformly in the top layer, near both B and B_2O_3 edge (194.1 eV). Near B edge, simulated profiles undergo no changes by incorporation of different at. % of B_2O_3, thus no sensitivity to B_2O_3 at these energies due to a flat optical behavior of B_2O_3 (see Fig I). However, tuning energy to B_2O_3 edge (194.1 eV), simulated curve undergoes strong variation along with significant change in the amplitude of the oscillations envelope. This is observed in the entire q_z-range by mixing even few at. % of B_2O_3 due to sharp change in optical properties of B_2O_3 at this energy. Similar bilayer structure modulation in amplitude of oscillations (as discussed earlier) is clearly visible by incorporating even 5% of B_2O_3 in the top layer also. The variations in simulated scattered spectral features provide evidence to probe presence of few at. % of B and B_2O_3 in the thin film structures by tuning energy to the respective absorption edges.