Channeling, focusing and nuclear reactions

Yu.N. Demkov

Institute of Physics, The University of St. Petersburg, St. Petersburg, Russia

A highly collimated beam of protons (≈ 1 MeV) entering the channel of a monocrystal film forms at a certain depth an extremely sharp (< 0.005 nm) and relatively long (some monolayers of the crystal) focusing area where the increase of the flux density can reach thousand times. Impinging atoms in this focusing area can undergo nuclear or atomic reactions with proper foreign dopants which disappear if the crystal is tilted from this position by only 10^{-3} radians. This effect can be called channeling superfocusing, in contrast to the ordinary fluxpeaking where the increase of flux density reaches only few times. Results are predicted by quantum mechanical model calculations and confirmed by channeling Monte Carlo simulations accounting for several properties of the real lattice [1, 2].

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[1] Yu.N. Demkov and J.D. Meyer, Eur. Phys. J. B **42**, 361 (2004).

[2] Yu.N. Demkov and J.D. Meyer, Symmetries and integrable systems: selected papers of the seminar (2000-2005) Ed. A.N. Sissakian, Dubna: JINR, D2-2006–136, V.1, 85 (2006).