Rashba effects in bulk wurtzite materials

CHIEH-LUNG WU, W.T. WANG, M.H. GAU, JIH-CHEN CHIANG, IKAI LO, H.F. KAO, Y.C. HSU, D.J. JANG, Department of Physics, National Sun Yat-sen University, Kaohsiung, Taiwan ROC., MENG-EN LEE, Department of Physics, National Kaohsiung Normal University, Yanchao, Kaohsiung County 82444, Taiwan ROC, CHUN-NAN CHEN, Department of Physics, Tamkang University, Tamsui, Taipei County 25137, Taiwan ROC — The spin-splitting energies in strained bulk wurtzite AlN are studied using the linear combination of atomic orbital method. It is found that strain and crystal field induce not only a Rashba linear-\(k(\alpha_{\text{wz}})\) but also two Rashba cubic-\(k\) terms (\(\gamma_{R}\) and \(\lambda_{R}\)) in the two-band \(k \cdot p\) Hamiltonian \(H_{SO}(\vec{k}) = (\alpha_{\text{wz}} - \gamma_{R}k_{z}^{2} + \lambda_{R}k_{z}^{2})(\sigma_{x}k_{y} - \sigma_{y}k_{x}) + H_{SO}^{0}\) where \(H_{SO}^{0} = (-\gamma_{0}k_{z}^{2} + \lambda_{0}k_{z}^{2})(\sigma_{x}k_{y} - \sigma_{y}k_{x})\) generates a cone-shaped minimum-spin-splitting (MSS) surface and \(\lambda_{0}/\gamma_{0} \approx 4\). As tensilely biaxial strain increases, the shape of the MSS surface changes from a hexagonal hyperboloid of two sheets in unstrained AlN to a hexagonal cone, and eventually becomes a hyperboloid of one sheet.

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Date submitted: 19 Nov 2009

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