The finite spin Hall effect in semicondutors NAOYUKI SUGIMOTO, Department of Applied Physics, University of Tokyo, SHIGEKI ONODA, Spin Superstructure Project, ERATO, Japan Science and Technology Agency, SHUICHI MURAKAMI, NAOTO NAGAOSA, Department of Applied Physics, University of Tokyo — We formulate the theory of the spin Hall effect taking into account the impurity scattering effect as general as possible with the focus on the definition of the spin current. The conserved spin current (Zhang *et, al.* [cond- mat/0503505]) satisfying the continuity equation of spin in the bulk is considered in addition to the conventional one defined by the anti-symmetric product of the spin and velocity operators. The condition for the non-zero spin Hall current is clarified from a generic viewpoint and the following new results for explicit models are obtained: (i) spin Hall current in Rashba model is non-zero on the non-delta impurity scattering potential, and (ii) spin Hall current vanishes in cubic Rashba model on the delta impurity scattering potential.

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