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Low field phase diagram of spin-Hall effect in the mesoscopic regime ZHENHUA QIAO, WEI REN, Department of Physics, The University of Hong Kong, Hong Kong, China, JIAN WANG, Department of Physics and the Center of Theoretical and Computational Physics, The University of Hong Kong, Hong Kong, China, HONG GUO, Center for the Physics of Materials & Department of Physics, McGill University, Montreal, PQ, Canada — When a mesoscopic two dimensional four-terminal Hall cross-bar with Rashba and/or Dresselhaus spin-orbit interaction (SOI) is subjected to a perpendicular uniform magnetic field B, both integer quantum Hall effect (IQHE) and mesoscopic spin-Hall effect (MSHE) may exist when disorder strength W in the sample is weak. We have calculated the low field 'phase diagram' of MSHE in the (B, W) plane for disordered samples in the IQHE regime. For weak disorder, MSHE conductance G_{sH} and its fluctuations $rmsG_{sH}$ vanish identically on even numbered IQHE plateaus, they have finite values on those odd numbered plateaus induced by SOI, and they have values $G_{sH} = 1/2$ and $rmsG_{sH} = 0$ on those odd numbered plateaus induced by Zeeman energy. For moderate disorder, the system crosses over into a regime where both G_{sH} and $rmsG_{sH}$ are finite. A larger disorder drives the system into a chaotic regime where $G_{sH} = 0$ while $rmsG_{sH} = 0$ is finite. Finally at large disorder both G_{sH} and $rmsG_{sH}$ vanish. We present the physics behind this 'phase diagram'.

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