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Intrinsic spin and momentum relaxation in organic single-crystalline semiconductors probed by ESR and Hall measurements[1]
JUNTO TSURUMI, ROGER HUSERMANN, SHUN WATANABE, CHIKAHIKO MITSUI, TOSHIHIRO OKAMOTO, HIROYUKI MATSUI, JUN TAKEYA, Univ of Tokyo — Spin and charge momentum relaxation mechanism has been argued among organic semiconductors with various methods, devices, and materials. However, little is known in organic single-crystalline semiconductors because it has been hard to obtain an ideal organic crystal with an excellent crystallinity and controllability required for accurate measurements. By using more than 1-inch sized single crystals which are fabricated via contentious edge-casting method developed by our group, we have successfully demonstrated a simultaneous determination of spin and momentum relaxation time for gate-induced charges of 3,11-didecyldinaphtho[2,3-*d*:2',3'-*d*']benzo[1,2-*b*:4,5-*b*']dithiophene, by combining electron spin resonance (ESR) and Hall effect measurements. The obtained temperature dependences of spin and momentum relaxation times are in good agreement in terms of power law with a factor of approximately -2. It is concluded that Elliott-Yafet spin relaxation mechanism can be dominant at room temperature regime (200 – 300 K). Probing characteristic time scales such as spin-lattice, spin-spin, and momentum relaxation times, demonstrated in the present work, would be a powerful tool to elucidate fundamental spin and charge transport mechanisms.

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