# Spin Hall Effect and Origins of Nonlocal Resistance in Adatom-Decorated Graphene


**J. M. Marmolejo-Tejada**
D. Van Tuan, X. Waintal, B. K. Nikolić, S. O. Valenzuela, and S. Roche

*Department of Physics and Astronomy, University of Delaware, Newark, Delaware 19716-2570, USA*
*School of Electrical and Electronics Engineering, Universidad del Valle, Cali AA 25360, Colombia*

Juan.marmolejo@correounivalle.edu.co



## Abstract

Recent experiments reporting an unexpectedly large spin Hall effect (SHE) in graphene decorated with adatoms have raised a fierce controversy. We apply numerically exact Kubo and Landauer-Büttiker formulas to realistic models of gold-decorated disordered graphene (including adatom clustering) to obtain the spin Hall conductivity and spin Hall angle, as well as the nonlocal resistance as a quantity accessible to experiments. Large spin Hall angles of ~0.1 are obtained at zero temperature, but their dependence on adatom clustering differs from the predictions of semiclassical transport theories. Furthermore, we find multiple background contributions to the nonlocal resistance, some of which are unrelated to the SHE or any other spin-dependent origin, as well as a strong suppression of the SHE at room temperature. This motivates us to design a multiterminal graphene geometry which suppresses these background contributions and could, therefore, quantify the upper limit for spin-current generation in two-dimensional materials.


## References


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## Figures

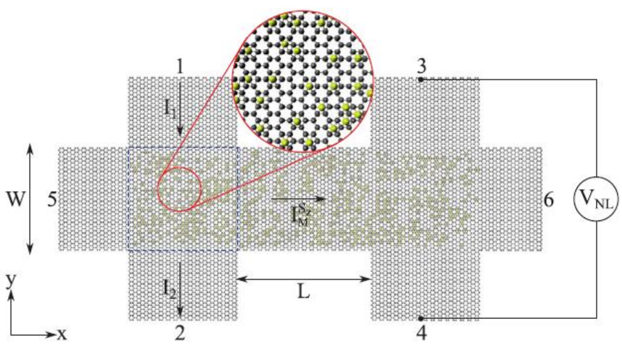


**Figure 1:** Schematic view of a six-terminal graphene device with gold adatoms

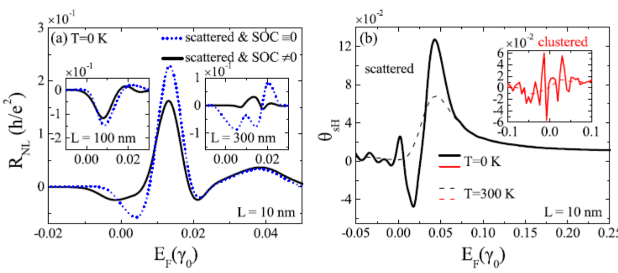


**Figure 2:** Nonlocal resistances and Spin Hall angle for six-terminal graphene in Fig. 1