

## Novel Transparent Conductor with Enhanced Conductivity: Hybrid of Silver Nanowires and Dual-Doped Graphene

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We present hybrid transparent conducting films based on silver nanowires (Ag NWs) and doped graphene (GP) through dual co-doping method by applying p-/n- type dopants on top and bottom sides of GP. We systematically investigated the dual-doping effect on their surface and electrical-optical properties of GP and Ag NW/GP hybrid films through the combination study with various dopants (p/p, p/n, n/p, and n/n). We found that p/p-type dual-doped GP and its hybrid with Ag NWs appeared to be the most effective to enhance electrical-optical properties of doped monolayer GP ( $\Delta R/R_0=84\%$ ,  $TT=97.4\%$ ) and Ag NW/doped GP hybrid ( $\Delta R/R_0=62\%$ ,  $TT=95.0\%$ ). Note that, dual-doping improved such electrical properties without any significant debilitation of optical transparency of conductors. In addition, the enhanced conductivity of p-type dual-doped GP allows a hybrid system to form co-percolating network in which Ag NWs can form a secondary conductive path at grain boundaries of polycrystalline GP.