Enhancement of integrity of graphene transferred by interface energy modulation

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We report on the systematic studies of the parameters governing the integrity of graphene film during general “wet” transfer from a thermodynamic point of view. We chose polystyrene (PS) as a test carrier material and attempted to use seven different solvents to find optimal conditions for the graphene transfer from a catalyst film to a desired substrate without defects. When parameterizing the conventional chemical properties of solvents, the boiling points and surface tension were found to be critical in determining the quality of the transferred graphene. During the formation step of a conformal PS film on a graphene surface before catalyst etching, a solvent with a boiling point over ~130°C was essential. During the following PS film removal step, a solvent with surface tension higher than approximately 30 dyne/cm led to the formation of a continuous graphene film without cracks and holes. In addition, a high spin-coating velocity and lower concentration of PS in the solvent enhanced the quality of a transferred graphene film. The UV treatment of Si/SiO₂ (100 nm) was also found to improve the adhesion of the graphene on substrates. By electrical characterization, morphological differences were found to affect the electrical properties markedly.