# Carbon nanotubes as nanodispensers for metals onto graphene

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By combining the TEM imaging and electron spectroscopy with a device allowing the application of a bias voltage, we were able to define conditions under which a reliable electrically controlled transfer of nanoparticles from the inner part of a CNT onto a FLG sheet can be performed. A Joule-induced annealing procedure has been designed to insure a reproducible behavior of the tube acting as the "pen" in the writing process. The tube filled with metal nanoparticles can reassemble, through an Oswald-like ripening mechanism, the encapsulated nanoparticles on the surface of the graphene sheet in a position-controlled way. The mass transfer requires four individual steps: the annealing of the tube, the chemical transformation or the reduction of the original particles, the particle transfer through the tube and the dispensing of the metal atoms on the graphene sheet. The voltage reversing is insuring the electromigration of the metal nanoparticles from the graphene surface in the nanotubes. The printing process mimics the process used in a "dye sublimation printer" and we therefore consider that this study is the proof-of-concept for the design of printing devices at the nanoscale.