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# Thermal Conductivity and Adhesion Strength of Boron Nitride Contained Pressure-sensitive Adhesives Films

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## Extended Abstract

Graphene (G) material with fascinating properties, such as, high carrier mobility and high optical transmittance, has become a promising candidate for transparent conducting film (TCF) applications as shown by Eda et al. (2009). Solution processed graphene films alone were found to be insufficient to have low sheet resistance required for display and graphene based composites with different types of metal nanowires are expected to exhibit better performance compared to graphene only as shown by Hecht et al. (2011). Composites of grapheme and Ag nanowires (NW) were prepared by spraying process and the effects of air- and ultrasonic spray on the properties of G/AgNW composites were investigated.

Ag NWs has the average length of ~18 um and the diameter of 50 nm and we used an air sprayed and an ultrasonic sprayer with nozzle diameter of 0.7 mm and frequency of 130 kHz. The simple solution spray of Ag NWs and graphene was employed to prepare G/AgNW composites

It is evident that the glass substrate was uniformly covered by AgNW and the highest degree of Ag NWs denseness was observed by air spraying. The length of AgNW was strongly dependent on the ultrasonic power and it decreased to ~ 10 um as low as 1.5 W of power.

The sheet resistances of the air- and ultrasonic sprayed AgNW, reduced grapheme oxide (rGO) and rGO/AgNW were compared. Air sprayed rGO/AgNW on a glass substrate exhibited a sheet resistance of ~300 ohm/sq. The ultrasonic sprayed rGO and sequentially air sprayed AgNW showed a significant improvement of sheet resistance to 50 ohm/sq. It implies that the dense network of air sprayed AgNW plays a dominant role to get a lower sheet resistance. The wire breakage and the sparse network of AgNW were observed for an ultrasonic spraying and the sheet resistance was too high to measure when the AgNW were coated using an ultrasonic sprayer. The loss of electrical connections between AgNW caused by an ultrasonic spraying was responsible for a higher sheet resistance.

The optical transmittance spectra of air sprayed and ultrasonic sprayed GO/AgNW films with different powers were measured. The transparencies of the composite films were shown to have dependency on the spraying volumes of AgNW and spraying power. All of ultrasonic sprayed graphene showed better transparency compared to the air sprayed films. The light transmittances of air sprayed and ultrasonic sprayed GO/AgNW films at a wavelength of 550 nm were 65% and 83%, respectively. The uniform and thin layer coating of graphene oxide by an ultrasonic spraying could be a reason for the significant improvement of light transmittance.

Synergistic effects of air- and ultrasonic spraying on the preparation of rGO/AgNW were found and the ultrasonic spraying was simple and effective for graphene coating and it can be further optimized for a large area TCFs.

## References

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