A New Paradigm for Graphene Synthesis: Transfer-Free Large-Scale, High-Quality Graphene at 150 °C on Polyethylene Terephthalate (PET) Substrates

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Direct graphene synthesis on flexible substrates via chemical vapor deposition (CVD) is an attractive approach to manufacturing flexible electronic devices, as it avoids the drawbacks of transferred graphene. To fabricate flexible devices on plastic substrates, the graphene synthesis temperature must be below ~200 °C to prevent substrate deformation.[1,2] In this study, high-quality graphene was directly synthesized on a variety of substrates via the introduction of ultra-thin titanium, which possesses a strong affinity for carbon. The various functions of neither the graphene nor the substrates were influenced by the graphene synthesis because the titanium was oxidized naturally upon exposure to air. Herein, we provide experimental evidence for large-scale (4 cm × 4 cm size), high-quality graphene grown on *10 nm-thick* titanium-catalyzed substrates at low temperatures (below 150 °C) under a CH_4/H_2 atmosphere via plasma-assisted thermal chemical vapor deposition (PATCVD). We applied the proposed methodology to the fabrication of flexible and transparent thin-film capacitors with directly grown top- and bottom-graphene electrodes. These findings could pave the way for a practical exploitation of flexible electronic devices via large-scale, high-quality monolayer graphene synthesized directly with no need for transfer processes.

References

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Figures

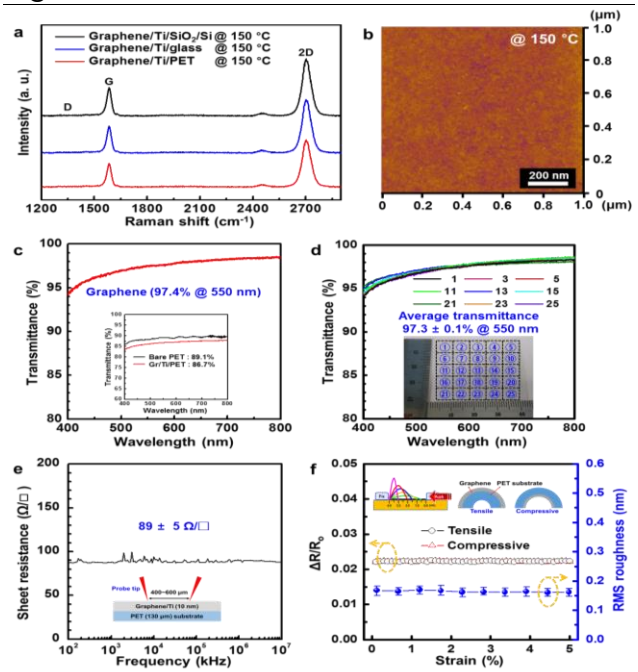

Figure 1: Experimental results of 4 cm × 4 cm Scale-garphene synthesized at 150 °C on PET Substrates.