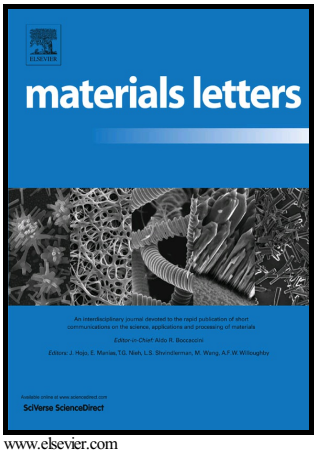

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Defect-free mixed mono- and bi-layer graphene synthesized from refined palm oil by thermal chemical vapor deposition

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Abstract

Growth of defect-free large-area mixed mono-and bi-layer graphene using refined cooking palm oil on nickel (Ni) via thermal chemical vapor deposition was demonstrated for the first time. Small surface roughness of Ni substrate was obtained by annealing in hydrogen (H_2) ambient. Small surface roughness of Ni substrate and introduction of high H_2 concentration during the growth improve the uniformity and suppress the formation of defect in the grown graphene. Coverage of mixed mono- and bi-layer graphene up to 65% was obtained. The grown graphene film showed an optical transmission of 80% at a wavelength of 550 nm, and a sheet resistance of 12.89 kΩ/sq. This work provides an alternative approach towards a development of less expensive growth technology using safe, easily obtained, low value raw carbon-containing precursor.

Keywords: Graphene, Carbon material, Chemical vapor deposition, Palm oil, Nickel

1. Introduction

Due to its extraordinary electrical, thermal, and mechanical properties, including a carrier mobility exceeding 10^4 cm^2/Vs [1] and a thermal conductivity of 10^3 W/mK [2], graphene has been widely investigated for various potential applications. However, most practical applications demand large-area, high quality mono- or bi-layer graphene films. Mechanical exfoliation of graphite can produce high-quality graphene, but the yield is low and flake size is comparatively small [3]. Graphitization of silicon carbide crystals at high temperatures can be used to produce large-area, high quality graphenes with controllable thickness [4]; however, the graphenes are non-transferable to arbitrary substrates. Thermal chemical vapor deposition (CVD) on catalytic metal surfaces [5,6] such as nickel (Ni) and copper (Cu) is the promising method to grow graphene with such specifications. For Ni, a mixed mono- and bi-layer graphene coverage of 87% has been reported [6,7], while for Cu foils, an average of 95% of surfaces were covered by mono-layer graphene [8]. CVD offers flexibility in