Synthesis of vertically aligned carbon nanotubes and diamond films on Cu substrates for use in high-power electronic devices

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Abstract: Currently, most of the vertically aligned carbon nanotubes (VA-CNTs) and diamond films are mainly synthesised on flat silicon (Si) substrate. However, to achieve thermal dissipation in high-power electronic devices (HPEDs), the VA-CNTs and diamond films need to be attached to thermal dissipation metal substrates (like Cu, Ag, Al, etc.). In this paper, the fabrication process of the VA-CNTs and diamond films on Cu substrate is reported in detail. The VA-CNTs were synthesised by the thermal chemical vapour deposition (CVD) method. The VA-CNTs on Cu substrates were fabricated by two different methods: directly growing the VA-CNTs using thin catalytic metal layers such as Fe/Al or Cr/Al as a catalyst transferring the VA-CNTs film that was pre-grown on Si substrate to Cu substrate. The diamond films were also directly grown on the Cu substrate by microwave plasma chemical vapour deposition (MPCVD). The grown VA-CNTs and diamond films were tested as the thermal dissipation media on a 0.5W InGaN LED chip. The VA-CNTs and diamond films greatly increased input current of the LED by more than 500 mA and 350 mA without reaching saturation. This is higher compared with that of the device packaged using normal commercial silver thermal paste. Initial experiment results on the LED demonstrated that the VA-CNTs and diamond films greatly improve the light's output power and that they are optimal choices for the thermal dissipation of HPED.

Author Keywords: Diamond; High-power electronic device; Thermal dissipation; Vertically aligned carbon nanotubes

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