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Thermal and electrical characterization of thin carbon nanotubes films

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The microelectronic industries are faced with fundamental limitations in the use of metallic typical wires which rise because of the continuous components size decrease. New current carriers must be used and/or new interconnects sheme must be found, as for exemple, the 3D integration solution. Parallelly, because of the nanoscale components size, it also arises the need of heat evacuation around active zones, because the heat generated by the active zones reduces systems performance and increases energy consumption. Vertically aligned carbon nanotubes (CNTs) films are good candidates as they are good conductive media for heat and current simultaneously.
To characterize their thermal and electrical properties, vertically aligned CNTs are first grown by RF-PECVD process. Then, a metal is deposited on the top of the CNTs film by magnetron deposition technique. The choice of the metal depends on the requirements of the characterization techniques used. The four-probe technique allow to measure the electrical conductivity. In this case, gold electrical contacts are necessary and are deposited as spots adapted to the probes size. The thermal properties are identified thanks to nanosecond pulsed photothermal technique which measures the surface temperature temporal evolution induced by a laser pulse. Absorbed laser energy increases surface temperature which leads to the emission of IR thermal radiations. A 1D model is applied which uses three identification parameters: the thermal conductivity of porous media, thermal resistance between porous media and transducer and heat capacity. In this case, Ti, W or Ni have been tested to answer the stringent conditions demanded by the pyrometry technique.

Keywords
CNTs
photothermal technique
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magnetron deposition