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Service de Physique de l'Etat Condensé
SÉMINAIRE THEMATIQUE
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Field Emission Cathodes made from Laser Cut CNT Fibers and Films

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Advanced cathode materials are needed to produce the stable, high current electron beams that are needed for compact, high power, high frequency, vacuum electronic devices. Current state of the art thermionic cathodes require high operating temperatures resulting in inefficient power consumption, poor reliability and reduced lifetimes. Alternatively, field emission (FE) cathodes offer the potential for significant reductions in power and cooling requirements for an operating device. FE cathodes made from carbon nanotube (CNT) fibers and films have demonstrated high emission currents, low turn-on voltages, long lifetimes and offer considerable potential for use as electron sources for vacuum electronic devices [1]. (CNT) fibers and films that were fabricated by direct online condensation from a floating catalyst chemical vapor deposition reactor. Both fiber and film cathodes showed stable emission in the current range of 1–2 mA at cathode temperatures less than 1000°C as measured with an infrared camera during field emission. A compound cathode made from four laser-patterned CNT films stacked together emitted greater than 8 mA of current. A cathode consisting of wound and cut CNT fibers with ~200 exposed cut fiber end emitted >10mA. Fowler-Nordheim analysis indicated a change in the morphology of the emitters as the cathode to anode distance was reduced. When field induced self-heating effects became significant, the single fiber cathode stopped emitting abruptly. For CNT films, even though self-heating effects can destroy a portion of the film, FE can still occur from other areas. These materials offer significant potential for use as cold cathodes in vacuum electronic devices.

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[1] S. B. Fairchild, J. S. Bulmer, M. Sparkes, J. Boeckl, M. Cahay, T. Back, P. T. Murray, G. Gruen, M. Lange, N. P. Lockwood, F. Orozco, W. O'Neill, C. Paukner, K. K. Koziol (2014). Journal of Materials Research, 29, pp 392-402.

The seminar will be given in English.