Use of HfC(210) as High Brightness Electron Sources:

We are demonstrating a new electron source for high brightness applications. Presently, commercial high-brightness sources operate in the extended Schottky emission (ESE) or cold field emission (CFE) modes both using tungsten as the base material. It is known that surface tension and electric field forces contribute to blunting or build-up on these W-based emitters which limits I', the angular intensity. Generally the maximum value of I' for ZrO/W sources is ~1 mA/sr.1 HfC sources can be operated at high temperatures and high fields without surface migration thereby not limiting I' to a relatively small range; HfC sources have been operated to >60 mA/sr. Reduced brightness calculations and comparisons to ZrO/W sources have been made. These data show the higher brightness levels with HfC and are the result of the high field at the apex.

Modeling and experimental performance on test stands and in a Philips XL40 FEG SEM (see Fig. 1) have been reported for HfC(210) and (110) cathodes where emission is studied for temperature ranges of 1800-1950 K. The field is high on these electro-chemically polished, curved end-forms giving rise to the very high optical reduced brightness levels to ~8 x 109 A/m2/sr/V.

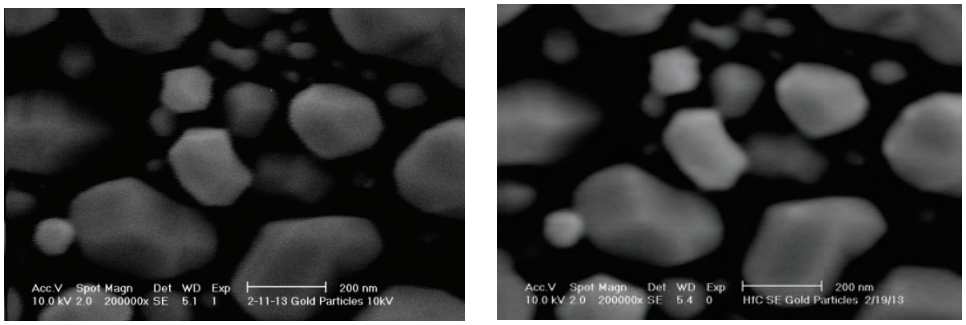

Fig. 1: Philips XL40 FEG SEM image comparison; ZrOW and HfC source images on left and right respectively

We have investigated operation in various pressures of ambient air to ascertain HfC's utility in this regime; pressures from 4 x 10-10 to 8 x 10-8 torr. As the pressure increases we find that the total current increases over time. The probe or beam current remains stable or increases slightly as well. Interestingly, these increases are not permanent but can be re-set to initial levels by reducing the pressure and field for several hours.

This data demonstrates the potential for the HfC(210) source. Higher angular intensities are possible as well as the potential for higher electron optical brightness which is due primarily to the ability to use the rounded emitter end-form in the Schottky emission regime.

1 L.W. Swanson and G.A. Schwind, in Handbook of Charged Particle Optics, edited by J. Orloff (CRC, Boca Raton, FL, 1997), Chap. 2, pp. 77-102.

Please contact **APTSales@a-p-tech.com** for more information on this exciting new source!

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