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Study on Field Emission Property of Single Crystal Hafnium Carbide Nanowire

The property of HfC nanowire, a typical refractory material, including high mechanical strength, low work function, outstanding chemical stability and high melting point make it a potential material for field emission application. [1-4] These properties are believed to affect the field emission performance by improving the brightness and stability of field emission.[3-5] In addition, the optimal geometry of nanowire could benefit the field emission emitter by reducing the turn-on voltage for field emission.[6,7] Typically, the prepared nanowire has irregular tip morphology and contamination absorbed on the surface which may affect the field emission performance of the nanowire and limited its application. In this research, <100> oriented Hafnium carbide nanowires have been synthesized using a chemical vapor deposition method. HfC nanowires were treated with field evaporation to clean and refine the shape of the tip. According to the SEM images and field emission microscopy, the tip of nanowire was sharped, and the field emission was localized at the tip apex after the field evaporation process. After the treatment, the field emission performance including field emission stability, the value of field emission current corresponding to the extraction voltage of HfC nanowire was obtained. Based on the results, the HfC nanowire is expected to be a promising material for cold field emitter.

References

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Figures

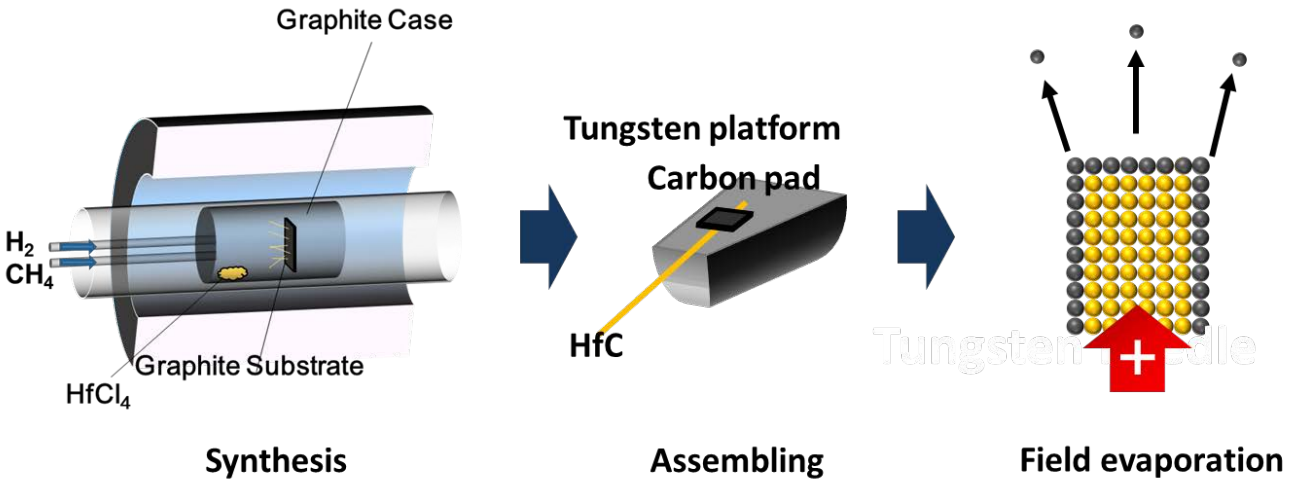

Figure 1: The illustration of the sample preparation procedure used in the research. Nanowires were synthesized by CVD and fixed on a tungsten platform via a carbon pad. A positive electric field was applied to field evaporate the nanowire in order to refine and clean it.

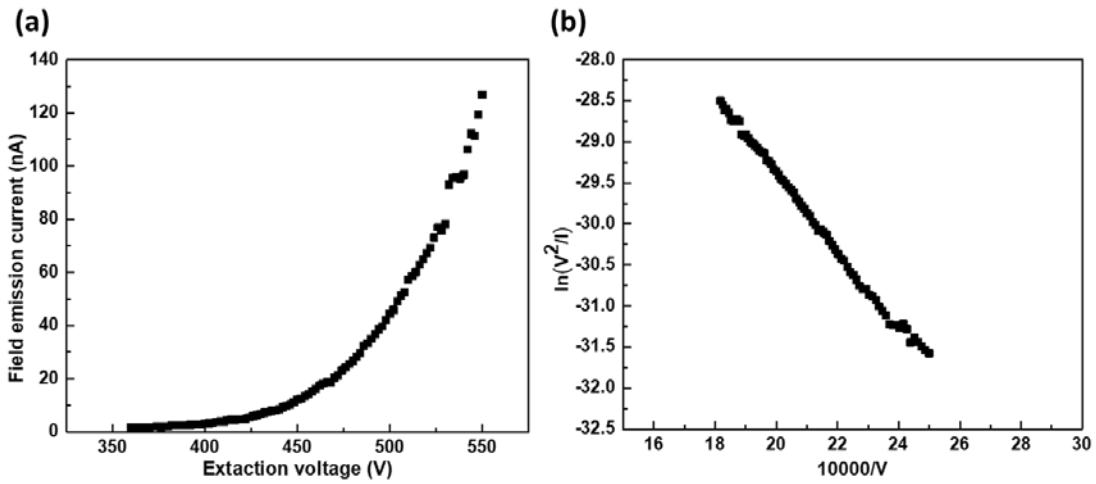

Figure 2: (a) The relationship between field emission current and extraction voltage (b) the F-N plot of the HfC nanowire emitter