Vertically Aligned Carbon Nanotubes Embedded in Ceramic Matrices for Hot Electrode Applications
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Challenges & Opportunities

Electrical conductivity (σ)
σ > 1 S/m, flux ≈ 1 amp/cm²

Thermal conductivity (k)
High heat flux from the combustion fluids at 2100 °C

Thermal stability
Melting point (T_m) above 2100 °C

Oxidation resistance
Resistant to an oxygen partial pressure about 10⁻² atm at 2100 °C

Corrosion resistance
Potassium seeds and aluminosilicate slags

Erosion resistance
High velocity hot gases and particulates

Thermionic emission
The anode and cathode should be good acceptor and emitters.

Materials Challenges of Magnetohydrodynamic Power Generator Electrodes

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Proposed Solution and Objectives

- Vertically aligned carbon nanotubes (VA-CNTs): Electrical and thermal conductive channels.
- Cubic boron nitride (c-BN): Protective layer shielding CNTs from erosive and corrosive environments.

Objectives
1. Super growth of VA-CNT carpets on metallic substrates;
2. Fabrication of CNT-boron nitride (CNT-BN) composite structures;
3. Stability and resistance studies of the CNT-BN composite structures; and
4. Thermionic emission properties of the CNT-BN composite structures.

Early Results

Preliminary Results

Growth of VA-CNTs

Controlled growth of CNT bridges

Low-temperature synthesis of GaN

Acknowledgement

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