CP 9

CONCEPT PAPER
for KIER International Cooperation project

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Title	Solid state electrochemical cell for high-grade thermal WHP (waste heat to power)			
Description	● Solid state electrochemical cell converts a high-grade thermal energy to electricity • Working principle is ionization of sodium: $Na \rightarrow Na^{+}$ + electron • Key material is ß"-alumina solid electrolyte (Na-BASE) • Key technology is joining of BASE to metal (hermeticity and strength of joining) • Electrode performance requires: robust bonding to BASE, controllable porosity, electrical conductivity, and sustainability under sodium environment • Operating temperature is in the range of 800 to 1200 K • Conversion efficiency approaches to the Carnot cycle by 75% to 85% ● Pressure difference between solid electrolyte is the key for high performance WHP ● Joining of solid electrolyte and metal is the weakest point for pressure leakage ● Thin porous electrode have to be develop on inner and outer surface of BASE ● Delegate should have specialty in one of the fields of joining or electrode ● Strategy: • With joining tech: if the joining performance have to be developed around 10^{-5} torr-l/s with vibration resistance and degradation resistance under 10% • Novel design: BASE is not attached to the metal part, therefore the joining is not required. • Electrode process for inside of tube type BASE is required. e.g. sol-gel and slurry type, c.f. magnetron sputter and any other process hardly form inner electrode.			
Outcomes*	● Efficiency of the system could be increase over 75% of Carnot cycle (current 15%) ● Cost down is promising (40,000 $/kW to 500 $/kW) ● Development of WHP system which has competitive advantage over Stirling engine ● Publications and Patents • 2 publications and patents for electrode process and joining technology • 1 publication and patent for the Novel design of system			