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10MW高温气冷堆首次装料的包覆燃料颗粒研制

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摘要 10MW高温气冷堆采用全陶瓷TRISO型包覆颗粒燃料元件。TRISO型包覆燃料颗粒由燃料核芯、疏松热解炭层、内致密热解炭层、碳化硅层和外致密热解炭层组成。本工作研究用于生产包覆燃料颗粒的具有多气体入口的新型喷动流化床和4层连续包覆工艺。采用化学气相沉积方法在150mm直径流化床沉积炉中生产出10MW高温气冷堆的包覆燃料颗粒。用扫描电镜观察研究了包覆燃料颗粒的微观结构。包覆燃料颗粒的制造破损率为 3.4×10^{-6} 。包覆燃料颗粒的辐照考验结果(包覆燃料颗粒的裂变产物 ^{85}Kr 释放率为 10^{-6})表明,包覆燃料颗粒的性能可以满足我国10MW高温气冷堆的设计要求。

关键词 [高温气冷堆](#) [包覆燃料颗粒](#) [流化床](#) [化学气相沉积](#)

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Research and Development on the First-loading Coated Fuel Particles for the 10 MW High Temperature Gas-cooled Reactor

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Abstract The 10 MW high temperature gas-cooled reactor (HTR-10) project uses spherical fuel elements with all ceramic TRISO type coated particles. The TRISO type coated fuel particle consists of a microspherical fuel kernel and coating layers of porous pyrolytic carbon, inner dense pyrolytic carbon, pyrolytic silicon carbide and outer dense pyrolytic carbon. A new type of spouted bed with multiple gas inlets and the successive four-layer coating processes were investigated for fabrication coated fuel particles. The first-loading coated fuel particles for HTR-10 project were fabricated in a 150 mm diameter fluidized bed coater by chemical vapor deposition. The microstructure of coated fuel particles was observed using scanning electron microscope. The failure rate of as-fabricated coated fuel particles is 3.4×10^{-6} . The result of irradiated experiments for coated fuel particles, the R/B ratio of the fission product ^{85}Kr is in the range of 10^{-6} , shows that the properties of coated fuel particles can meet the design specification of HTR-10.

Key words [high temperature gas-cooled reactor](#) [coated fuel particles](#) [fluidized bed](#) [chemical vapor deposition](#)

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