High Temperature Gas-cooled Reactors (HTGRs) are safe next-generation reactors with cores that will not melt. Further safety improvements of the HGTR relies on improve the oxidation resistance of the fuel for the severe oxygen ingress into the core, because almost volume of the cores of the HTGRs consist of graphite (solid C, but not diamond). The graphite is oxidized into CO or CO$_2$ in the oxidation atmosphere at high temperatures.

A small sphere containing fissile materials is coated with layers of ceramics to form a coated fuel particle (CFP) approximately 1 mm in diameter. A mixture of CFPs, graphite powder, and resin is sintered to form a fuel compact. Fuel compacts are put into a graphite sleeve to form a fuel rod. Fuel rods are put into holes of graphite block to form fuel block.

Simulated CFPs (alumina particles) and binding material (Si powder, graphite powder and resin) were molded and sintered into a simulated fuel compact (Fig.6-7(a)), which was then oxidized in He including 20% O$_2$ at 1673 K for 10 h. The fraction of O$_2$ was set to be similar to air. After oxidation (Fig.6-7(b)), all simulated CFPs were kept in the simulated fuel compact. On the other hand, in a past study, a part of CFPs were loosened from a fuel compact with the graphite binding material after oxidation in air at 1673 K for 2 h (Fig.6-7(c)). Thus, it was shown that the oxidation resistance of the fabricated simulated fuel compact is better than that of the fuel compact with graphite binding material or not.

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Reference
