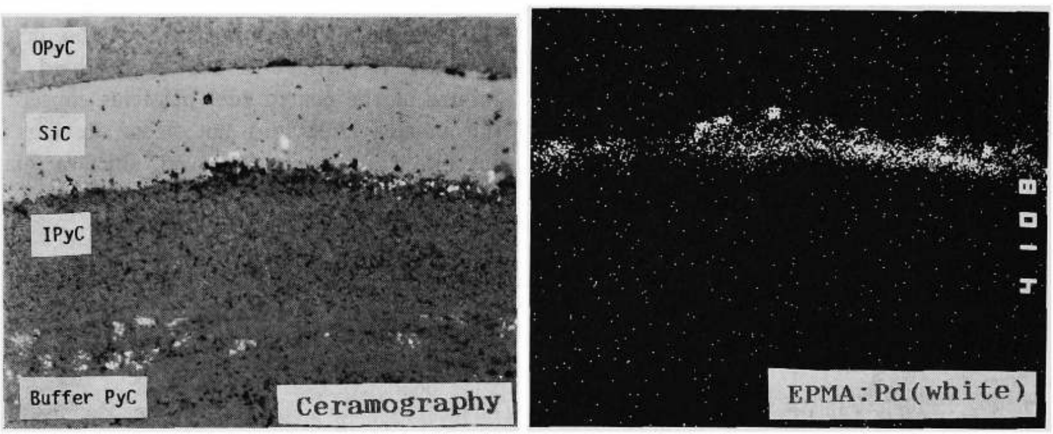
mum range of the kernel migration estimated from Fig. 5 was less than 55 μm in the fuel-life time which was smaller than thickness of the buffer layer.

The interaction between Pd and SiC coating layer (Pd/SiC interation) was concerned about the low-enriched uranium (LEU) fuel, because the fission yield of Pd increased with decreasing ^{235}U enrichment in the same burnup. Although Pd formed precipitates with other metallic fission products in UO_2, it was released easily from the kernel due to very small solubility in UO_2 matrix and high vapor pressure, and diffused through the buffer and inner PyC layers(10). The Pd accumulated in the inner surface of the SiC layer interacted with SiC forming intermetallic compounds such as Pd_2Si(11). A rate-limiting step in this attack was considered to be supply of Pd from the kernel, since the Pd/SiC interaction and diffusion of Pd through the buffer and inner PyC layer were fairly fast compared with the release from the kernel(10)(11).

In **Photo. 1** showing a ceramograph and Pd-L_α X-ray image by Electron Prove Micro Analyzer (EPMA), penetration of intermetallic compounds, Pd_2Si, into the SiC coating layer was recognized. This reaction exacerbated the SiC coating layer, which led to loose the ability for retention of the fission products. The Pd/SiC interaction in the HTTR reference fuel had been investigated intensively in PIE where penetration depth of the intermetallic compound was observed in the sectioned SiC coating layer of the irradiated coated particles by EPMA and ceramography(12).



White precipitates near inner surface of the SiC layer is composed of Pd as detected by EPMA (right).

Photo. 1 Typical example of Pd/SiC reaction observed in irradiated coated-fuel-particles by ceramography (left) and electron-prove microanalyzer, EPMA (right)

In **Fig. 6** the penetration depth is depicted against the amount of Pd released from the kernel, which was calculated with functions of diffusion coefficients of Pd in the UO_2 kernels, irradiation temperature and time, burnup and so on. It was found that a relationship between the maximum penetration depth and an amount of Pd release was expressed by a cubic root low, from which the maximum penetration depth of the HTTR fuel during the fuel-life time could be estimated(13). This result suggested that the penetration depth during the fuel-life time was about 11 μm, which was less than a half of the SiC layer thickness (25 μm), therefore, proving integrity of the coated fuel particles(14).

2. Fission Product Release

In-situ fission gas release from the fuel, which was deeply related to the irradiation performance of the fuel, was measured by OGL-1 and the gas swept capsules. The OGL-1 was the in-pile gas loop installed in JMTR, where a fuel block containing one or three fuel rods could be irradiated at high-temperature and high-pressure (about 4 Pa) gas flow(15).