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The mineralogy and defect microstructure of Hayabusa particle RB-QD04-0042.

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JAXA provided us the particle RB-QD04-0042 which was recovered from the surface of the asteroid 25143 Itokawa by the Hayabusa space probe. The objective of our study was to elucidate the shock-metamorphic state of asteroidal regolith material.

The particle received had a size of $40 \times 50 \mu\text{m}$ and was serially sectioned by FIB using a specifically designed protocol in order to preserve the original microstructural inventory. We conducted detailed studies by analytical scanning (SEM) and transmission electron microscopy (TEM) of the grain's surface and interior.

In spite of its small size, RB-QD04-0042 contains a variety of minerals: The major phase olivine was found to host a nearly spherical inclusion of diopside and an angular, composite inclusion of troilite and tetrataenite with an equimolar Fe/Ni ratio. Locally, the olivine contains dense arrays of [001] dislocations while adjacent regions are virtually defect-free. Tetrataenite contains abundant spinel-type microtwins. Both types of microstructures clearly indicate a shock-metamorphic overprint on RB-QD04-0042.

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