Supporting Information

Detailed descriptions for the depth profiling analysis of the laser pit

The laser pit parameters of three minerals samples, such as diameter and depth, were investigated using a white light inter-ferometric microscope (NewView, Zygo Corporation) at Tsinghua University in Beijing. Figure 1s a-c illustrate the craters formed on 10AFK-2 perovskite during a laser ablation of 43 seconds at a spot size of 60 μm, a repetition rate of 6 Hz and a fluence of 5 J/cm^2. The depth of acquired laser pit was 27.540 μm, which is smaller than the crater diameter of 61.869 μm. In the analysis process of OLT-1 titanite, with the purpose of improving the sensitive for the lower U, Pb and Nd content, a laser ablation procedure involved a spot size of 90 μm, a repetition rate of 10 Hz and a fluence of 9 J/cm^2. The depth of the crater after 43 seconds of laser ablation was 57.848 μm, which smaller than the crater diameter of 96.794 μm (Figure 1s d-f). Considering a higher U, Pb and Nd content of the Namaqualand monazite, the laser ablation system was operated at a smaller spot size of 24 μm, a repetition rate of 6 Hz and a fluence of 5 J/cm^2. However, a laser ablation of 43 seconds produced a depth of 32.830μm, which is slightly larger than the crater diameter of 28.021μm (Figure 1s g-i). Therefore, a further experiment was conducted using a larger spot size of 90 μm. The result was represented by Figure 1s j-l with the depth of 30.406 μm comparable to the depth of 24 μm spot size. In view of this, a spot size larger than 33 μm, such as 44 μm, should be utilized for the measurement of monazite samples to ensure that the spatial resolution is determined by the laser spot size.

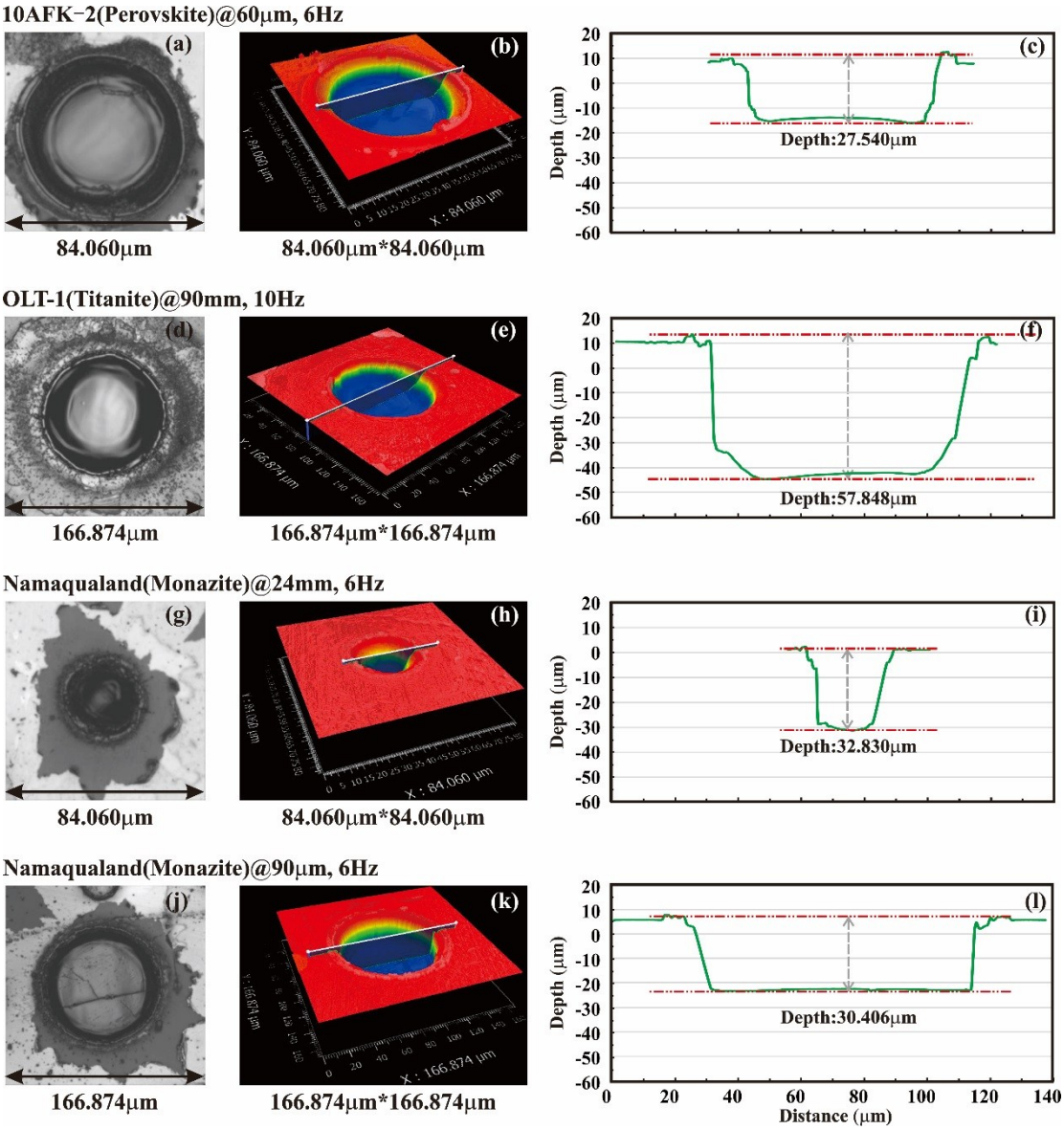

Figure 1s. 2D photomicrographs, 3D images and cross-sectional profile of the laser pit characterized by a white light interferometric microscope for (a-c) 10AFK-2 perovskite; (d-f) OLT-1 titanite; (g-i) Namaqualand monazite with spot size of 24μm; (j-l) Namaqualand monazite with spot size of 90μm.