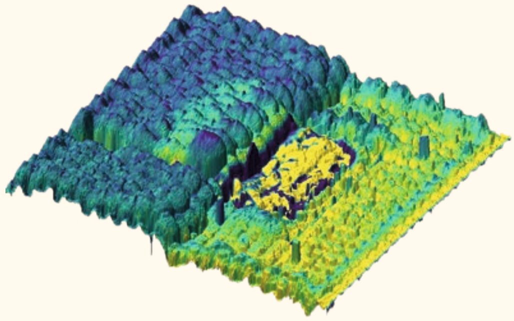

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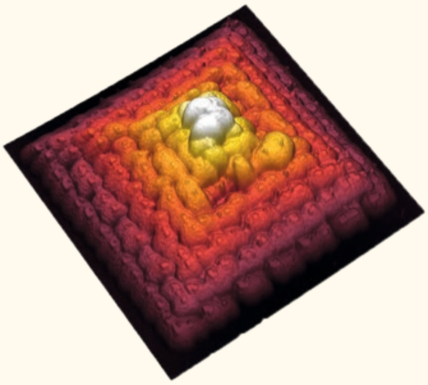

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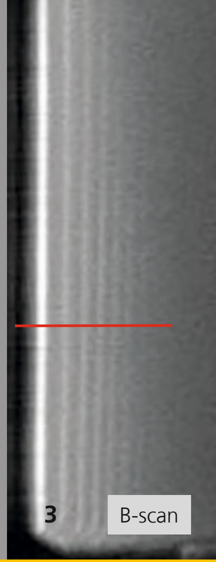

3

OCT FOR THE CHARACTERIZATION OF 3D-PRINTED CERAMIC OBJECTS

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Additive manufacturing (3D printing) of advanced ceramics offers the possibility to create highly specialized structures. Their very specific geometry and finely tuned mechanical, thermal, and electrical properties require the highest quality standards even during manufacture. This can be realized with in-line monitoring methods, such as optical coherence tomography (OCT).

Non-destructive OCT uses a laser beam to illuminate a small area on the sample surface. While part of the beam is reflected from the surface, a portion of it can propagate into the sample, where the light is backscattered from inclusions, delamination, pores, and other defects. The local variations alter the path of the laser beam. The backscattered light interferes with a reference signal, allowing the extraction of information about the sample interior. This complex diffraction pattern is analyzed with the fast Fourier transform (FFT) method to yield variations in the light intensity as a function of the sample depth. This signal is called A-scan and it is repeatedly recorded in a line across the surface. As a result, a cross-section image (B-scan) of the sample is obtained. The acquisition of laterally spaced B-scans yields a tomogram containing volume-related information.

Detecting defects and material variations in the object

Figure 1 shows a combination of geometry and material variations extracted from a tomogram measured on a ZrO_2/support material probe. The dimensions of the structure can be extracted and compared with those parameterized for printing. Subsurface defects and material variations can be detected, and the information can be used to optimize the printing process. The topography of a printed pyramid is shown in Figure 2. Both structures were printed in a multi-material jetting process. The B-scan presented in Figure 3 shows several layers of a ZrO_2 probe printed via a lithography-based process. At the marked position, an A-scan was extracted, as shown in the diagram below. The positions of the peaks clearly identify the layer interfaces. This allows tracking of variations in layer thickness – a perfect indicator for the stability of the printing process.

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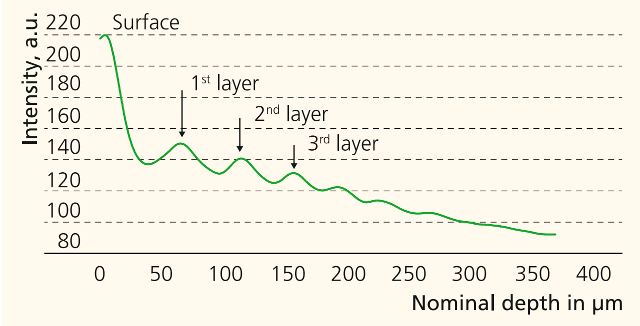

1 *Topography and material variations in printed test structure.*

2 *Topographic reconstruction of a printed pyramid structure.*

3 *B-scan of a ZrO_2 probe.*

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