Abstract

Non-Destructive Testing of Corundum Grinding Wheels for cracks and inhomogeneities

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In recent years all-electronic terahertz sources have been made available. These units are compact, mobile and easy to use and therefore ideal for non-destructive testing purposes. We are presenting results achieved using sources running at 0.1 THz in a portable unit (SynViewCompact). The system operates in reflection as a frequency modulated continuous wave (FMCW) radar.

The grinding wheels show rotational symmetry and have a cylindrical hole. The investigated outer diameters and wheel thicknesses vary between 100 mm and 400 mm, the cylindrical hole between 50 and 150 mm. During inspection the grinding wheels (weight 5 kg - 25 kg) are rotated by using a rotational stage. The center hole is filled with an Al cylinder to improve the backwall echo after penetration of 50 - 100 mm grinding material.

For several reasons the non-destructive testing is done after the firing process and before final finishing. On one hand the attenuation of the used terahertz radiation inside the material before firing is typically too high to get good results. On the other hand it is more convenient to inspect before finishing because of a more simple geometry of the wheels in this case. Also, for cost saving reasons the last production process could be saved in case the part is fail anyway.

Background for introducing non-destructive testing into the production of corundum grinding wheels, in particular for diameters >200 mm, are increasing requirements and potentially severe damages and cost due to breaking wheels inside operating grinding machines. The achievable penetration depth using 0.1 THz radiation depends on several parameters, in particular the type of material and its porosity. For some kind of wheels a penetration depth of up to 200 mm can be achieved.

The new non-destructive method is an effective way to clearly detect hidden cracks and other inhomogeneities in grinding wheels of the above mentioned size. Also, we observed density variations resulting in variations of the optical thickness of the wheels (refractive index is appr. 2.0). All this information allows to optimize grinding wheel production processes and to establish an effective control of goods out or goods in. The inspection time per wheel is 1 - 5 minutes, depending on the required data quality.