1.5.6. VISUALISATION OF TRANSPORT AND DAMAGE PROCESSES IN DIFFERENT MATERIALS BY LASER INDUCED ACTIVE THERMOGRAPHY

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In the field of non-destructive testing of materials, the method of active thermography is increasingly applied. It is mainly used for the assessment of the structure and the properties in the region near the surface of the object under investigation.

In most cases, it is applied to investigate the material properties or the existence of internal faults of structural elements. But as active thermography is a contactless and fast method, and as environmental influences are detected by this method, it can also be applied in situ, i.e. while material properties, conditions or the load case of the structure under investigation are changing.

This presentation reports about the use of laser-induced thermal excitation for the monitoring of transport and damage processes in different materials such as wood, sandstone, brick, monolithic ceramics and metal with an infrared camera.

A Nd:YAG laser with a wavelength of 1064 nm and an output power range from 1 to 1000 W is used to heat the investigated material locally. A line or a more complicated structure is scanned along the surface of the sample. During and after excitation, the heat diffuses into the material. This heat transport depends on the thermal material properties, i.e. the density, the specific heat capacity and the thermal conductivity. These properties are strongly affected by environmental influences as e.g. moisture, diffusing agents or structural disorders (cracks, microcracks, density variations). Consequently, moisture and damage are changing the local heat transport at the surface. Also the time dependence of inhomogeneities, as e.g. moisture transport or crack growth can be detected by this method as these processes are superimposing the heat diffusion and therefore result in a modified temperature distribution at the surface. This temperature distribution is recorded during and after heating with a mid wave infrared camera (InSb FPA, 3 to 5 μm) with a full frame rate of about 100 Hz.

For the reconstruction of spatial and time resolved variations of material properties and for the detection of inhomogeneities, sophisticated image processing tools were developed. Experimental results will be shown and discussed. These will be compared to analytical and numerical simulations.