



OPTICS

## TRANSPARENT AND OTHER OPTICALLY ACTIVE CERAMICS FOR OPTICAL APPLICATIONS

Dr. Isabel Kinski, Dr. Michael Arnold, Dr. Stefan Barth, Dr. Uwe Partsch

For maximizing luminous and lighting efficacies, the technological approaches used for designing high-performance lighting applications tend to employ polycrystalline ceramic converter materials.

Fraunhofer IKTS takes different routes in the development of phosphor powders and ceramic converter materials. Besides commercially available raw materials, precursors and educts are synthesized in bottom-up synthesis processes. Nanoscaled phosphor powders can be produced or further processed according to requirements using the classic ceramic route with shaping and sintering to form ceramic bulk components.

High transparencies can be achieved by eliminating defects and secondary phases by controlling the ceramic process. With a defined porosity incorporated in the ceramic, scattering effects can be tailored leading to higher luminous efficacies. Homogeneous dispersion of the phosphor in other inorganic matrices (ceramics) provides a means of adjusting the thermal conductivity and the thermal expansion coefficient. By printing phosphor powders, component labeling can be realized as well. Commercially available phosphor powders have successfully been used in the development of pastes for screen printing as well as inks for labeling components in a hot forming process.

Other phosphor conversion materials developed at Fraunhofer IKTS can be excited by standard blue light for white lighting (e.g. YAG:Ce) but also with UV light or other wavelengths. Depending on the thickness of the ceramic, different emission colors (red, green, orange, or yellow) can be produced, by

either total or partial conversion of the excitation light through additive color mixing.

Besides the conversion of the excitation wavelength, other ceramic phosphor properties have been employed in the development of diagnostic materials. For example, a reversible temperature-dependent afterglow can be used in thermal history sensors.

- 1 Printed phosphor powder for component labeling.
- 2 Red phosphor for thermal history sensing with thermally triggered phosphorescence.
- 3 Transparent YAG:Ce for solid-state lighting applications.