# CERAMIC INVESTIGATIONS IN THE SYSTEM $CaO$-$Al_2O_3$-$ZnO$

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The ternary system $CaO$-$Al_2O_3$-$ZnO$ has been studied since the 1960s with a special focus on the influence of zinc oxide on the properties of the calcium aluminates occurring in Portland cement clinkers (AKATSU et al., 1968). In an investigation by BARBANYAGRE & TIMOSHENKO (1996), single crystals of two different calcium zinc aluminates ($Ca_{14}Al_{10}Zn_6O_{35}$ and $Ca_3Al_4ZnO_{10}$, respectively) have been synthesized and their crystal structures and crystallochemical properties have been determined. In recent years, both ternary compounds have seen a revival of interest. After doping with $Ti^{4+}$, $Ca_{14}Al_{10}Zn_6O_{35}$ can be used as an attractive material for phosphor production due to its very good luminescence properties, environmental safety and low-cost components (WU et al., 2019). In addition, the phase offers an extraordinary potential as an optically transparent ceramic material for a wide range of applications. However, previous studies also have shown that one of the major requirements for optical ceramics - sufficient phase purity - has not been achieved yet.
In the course of this investigation, selected synthesis routes aiming on the preparation of phase-pure $Ca_{14}Al_{10}Zn_6O_{35}$ ($C_{14}A_5Z_6$) have been evaluated. First, a number of conventional solid-state syntheses were performed using sinter temperatures between 1000 °C and 1250 °C. Qualitative and quantitative phase analyses of the sinter pellets obtained were carried out by means of powder X-ray diffractometry (PXRD). While $Ca_{14}Al_{10}Zn_6O_{35}$ only occurs in small proportions at temperatures below 1200 °C, sublimation of zinc oxide at higher temperatures results in the formation of zinc-free secondary phases. The highest yield of the target phase (96 wt.-%) could be obtained in the sample fired at 1220 °C (4 x 16 h with intermediate grinding). Furthermore, powder preparations using wet chemical methods based on solution-precipitation as well as sol-gel syntheses were examined. Applying a modified sol-gel process, also known as the Pechini or polymer precursor method, it was possible to obtain a highly reactive amorphous precursor that yielded an almost phase-pure product (98 wt.-%) after a single run of 16 hours at the maximum temperature of 1220 °C. Using this specific precursor, *in-situ* high-temperature PXRD experiments indicate that the sintering temperature can possibly be further reduced to 1150 °C.

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