

# EFFECT OF ALKALI IONS ( $\text{Na}^+$ , $\text{K}^+$ , $\text{Cs}^+$ ) ON REACTION MECHANISM OF CZTS NANO-PARTICLES SYNTHESIS

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The control of morphology, elemental composition and phase composition of  $\text{Cu}_2\text{ZnSnS}_4$  (CZTS) nano-crystals depends on the control of complex formation and surface stabilization of nano-particles in solution-based synthesis in oleylamine. At temperatures  $\geq 280^\circ\text{C}$ , the control of nano-crystal's morphology and homogenous growth is difficult because of fast poly-nuclear growth occurring at higher temperatures. In the present work the effect of oleylamine complex formation with different alkali ions ( $\text{Na}^+$ ,  $\text{K}^+$  and  $\text{Cs}^+$ ) on nano-crystals growth at synthesis temperature of  $280^\circ\text{C}$  was studied. It was found that nano-powders synthesized in the presence of  $\text{Na}^+$  and  $\text{K}^+$  ions showed the formation of crystals of different sizes - small nano-particles (18 nm-30 nm), large aggregated crystals (few nm to  $1\text{ }\mu\text{m}$ ) and large single crystals ( $1\text{ }\mu\text{m}$  -  $4\text{ }\mu\text{m}$ ). The presence of  $\text{Cs}^+$  ions in the nano-powder synthesis in oleylamine-metal precursor- $\text{CsOH}$  solution promoted growth of nano-crystals of homogenous size. It is proposed that the formed oleylamine- $\text{Cs}$  complexes a) enhance the formation and stabilization of oleylamine-metal ( $\text{Cu}$ ,  $\text{Zn}$  and  $\text{Sn}$ ) complexes before the injection of sulphur precursor into the oleylamine-metal precursor solution and b) after addition of sulphur stabilize the fast nucleated nano-particles and promote diffusion limited growth.

