**Abstract**

In this master thesis, a fast and facile route to small, pure and oxygen-free LnF3 nanoparticles with enhanced physico-chemical properties is presented. In the first part, the influence of the different reaction parameters on the crystallinity, the morphology, the particle size, the emission and excitation spectra, the local symmetry surrounding the Eu3+, the luminescence lifetime, the 5D0 quantum efficiency and the color of emission, was evaluated. The reaction time in the microwave was studied. An increase of the size (8-12 nm) of the nearly spherical particles with prolonged reaction time is observed. When changing the amount of ionic liquid, a stronger agglomeration is observed in the particles made with an equimolar ratio of BmimBF4 due to the missing additional stabilization of the IL. In addition, a great excess of IL lead to a slightly smaller particle size and a decrease in the 5D0 quantum yield. The influence of the reaction time in an autoclave is small. However, the morphology is different when comparing it to the particles obtained in the microwave. Tiny nearly spherical particles of about 5 nm size form large agglomerations of a column-like shape. In the luminescence spectra, only the decrease of the asymmetry ratio when extending the reaction time is noticeable. This tendency may be due to annealing. In order to define the impact of the conversion method and to confirm this assumption, particles were synthesized in the microwave and in an autoclave with two different ionic liquids. A column-like morphology is obtained with the synthesis in the microwave, whereas the conversion in an autoclave yield nearly spherical particles with no obvious agglomeration shape. No significant conclusions about the particle size can be drawn. However, the asymmetry ratios calculated from the emission spectra indicate a lower symmetry of the particles synthesized in the microwave supporting the assumption of a slight annealing effect when using conventional heating. To study the influence of the ionic liquid, first changing the anion from BF4 to PF6 is regarded. The powder diffraction pattern reveals a noticeable influence on the crystallinity. In case of the imidazolium and phosphonium PF6-ILs, the particles exhibit also phase impurities. In addition, the emission spectra show an opposite asymmetry ratio of this two samples referring to a lower local symmetry surrounding the Eu3+ ion. Furthermore, the particles synthesized from BmimPF6 and P66614PF6 exhibit an enhanced 5D0 quantum yield of up to 45% at low temperature. In combination with the orange-red emission colour of this two samples, a noticeable effect on the characteristics of the particles can be confirmed. However, when using the pyridinium IL, no significant effect occurs. Therefore, the influence of the cation of the IL on the properties of the synthesized particles is also evaluated. Noticeably, the TEM measurements reveal different morphologies. Cuboid particles forming rows, a rod-like particle shape, spherical particles without any ordered agglomeration as well as spherical particles forming column-like morphologies are observed. The emission spectra lead to slightly larger asymmetry ratios for the particles made from phosphonium ILs, which exhibit a rod-like or long cuboid shape. A preferred growth direction is assumed explaining the lower symmetry surrounding the Eu3+ ion. The quantum efficiency of the particles synthesized from CholinBF4 show with 60% (77 K) the highest value obtained in this study. The particles synthesized with PF6-ILs show significantly different powder diffraction pattern. Apart from the reflections of the hexagonal EuF3, some additional reflexes cannot be assigned. Except for particles prepared from BPyPF6, all emission spectra show a considerably higher asymmetry ratio pointing to a lower site symmetry. In consequence, the calculated quantum efficiencies are high and values of up to 42% can be even achieved at room temperature. In addition, the color can be tuned from orange to orange-red. The particles synthesized without additional solvent exhibit a similar behaviour. Although the PXRD mainly consist of reflections which can be assigned to the hexagonal phase, also some phase impurities can be detected. The asymmetry ratios change significantly in comparison to the particles synthesized from the same ionic liquid but with the use of ethylene glycole as co-solvent. However, also impurities in form of a broad band, which is probably connected to the imperfect removal of the ionic liquid in the washing process, are detected in one sample. As a result, the emission colour of this sample exhibit the biggest yellow contribution of all synthesized particles. In conclusion, predominantly pure hexagonal EuF3 nanoparticles with an average size of 4-15nm are synthesized. Different morphologies are obtained. In addition, the emission spectra show the characteristic sharp line emission of Eu3+ according to the 5D0 → 7FJ transitions. The asymmetry ratio yield information about the local symmetry surrounding the Eu3+ ion, which can be strongly influenced by the choice of ionic liquid. Furthermore, the impact of the used IL on the luminescence lifetime lead to a change in the 5D0 quantum yield, which is calculated to be in the range of 1-60 %. Besides, the emission color can be tuned from orange to orange-red. In a second part, the established method was applied to the synthesis of quantum cutting GdF3:Eu nanoparticles. The characterization reveals an average size of 6 nm of the nearly spherically shaped particles. By means of the luminescence spectra, possible quantum cutting behavior is proposed due to the confirmed energy transfer and the presence of transitions from higher lying emitting states. The measured decay times of the samples are long (about 10 ms) in comparison to other simple compounds and the pure EuF3 (0.7 ms). However, Bednarkiewicz et al. reported a grain size dependent increase of the luminescence lifetime with decreasing averaged grain size [65] in NaGdF4 nanocrystals. Therefore, the minute particle size can explain the long lifetime. The calculated CIE color coordinates show a slight shift of the emission color from orange-red in case of the pure EuF3 particles to yellow-orange in case of the GdF3:Eu samples. In order to confirm and quantify the quantum cutting abilities, synchrotron radiation measurements were carried out on samples with different doping level. Quantum efficiencies of about 125 % (10 % Eu3+ doping) and 145 % (5% Eu3+ doping) are found, respectively, which renders these materials of great interest for optical applications. In a next step, the conclusions drawn from the study of the different reaction parameters on the properties and optical behavior of EuF3 particles may be transferred to the synthesis of quantum cutting GdF3:Eu particles. The influence of varying the ionic liquid on the morphology and quantum efficiency will be determined.