Size-tunable Synthesis of CdSe Quantum Dots via Microwave Enhanced Process in Absence of Hot Injection Technique: Optical, Structural and Computational Studies

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Over the past decade, quantum dots have received much more attention from researchers working in various disciplines due to their quantum confinement effects and the size-dependent optical properties. As an important semiconductor material, various synthetic approaches have been reported to synthesize CdSe nanocrystals, such as hydrothermal, sonochemical, electrochemical route, and so on. However, Most of them used either toxic and costly materials (solvents, ligands or reagents) or high temperature injection techniques to synthesis CdSe nanocrystals. At the same time, it is not easy to control the particle size since they used hot injection techniques at high temperature.Herein, we develop a simple, mild, environmentally benign, low temperature and user-friendly microwave enhanced process for the synthesis of CdSe quantum dot with satisfactory size and quality with out hot injection techniques. The optical properties and particle size of the as prepared CdSe quantum dots can be controlled by change the microwave reaction conditions such as temperature, time and power.

Figure 1 shows the XRD patterns of CdSe quantum dots prepared at different reaction time (a) and temperature (b) under microwave heating. The XRD patterns shows that the as prepared CdSe QDs show zinc blende characteristic features appearing at about 25, 42, and 49° corresponding to the (111), (220), and (311) planes of the cubic phase of CdSe, respectively. The gradual narrowing down of the XRD patterns with increasing temperature and reaction time reflects an increasing size of the products. In addition, the relative increase in intensity and the sharpness of the diffraction peaks with the higher reaction temperature and time shows that the higher reaction temperature and time leads to a better crystallization of the products.

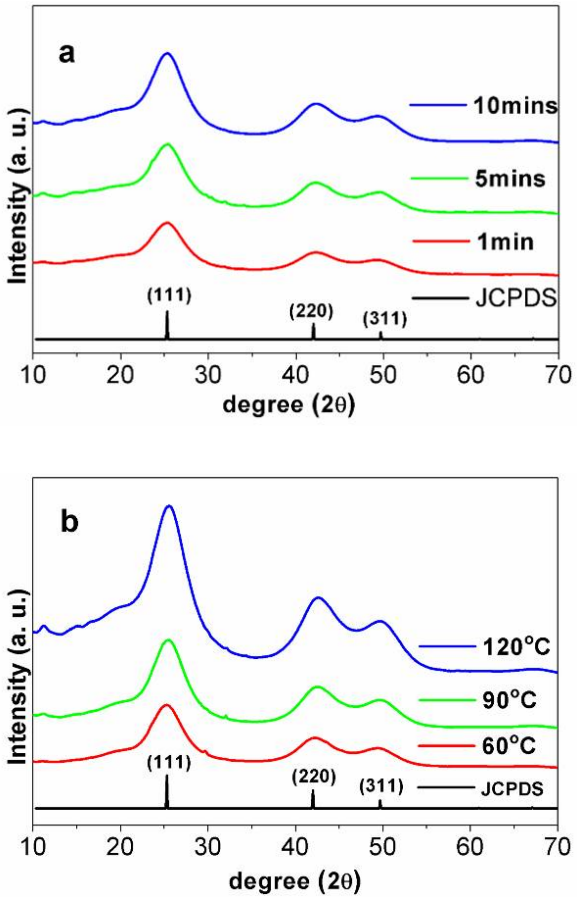

Fig. 1: XRD patterns of CdSe quantum dots with (a) different reaction time (b) different reaction temperature.