

Optical properties of Zinc oxide nanoparticles

ZnO is a wide band gap semiconductor that displays luminescent properties in the near ultra violet and the visible regions. The emission properties of ZnO nanoparticles in the visible region widely depend on their synthetic method as they are attributable to surface defects. Recently, we have developed a novel organometallic synthetic method for the preparation *at room temperature* of crystalline ZnO nanoparticles of controlled size and shape.^[1-3]

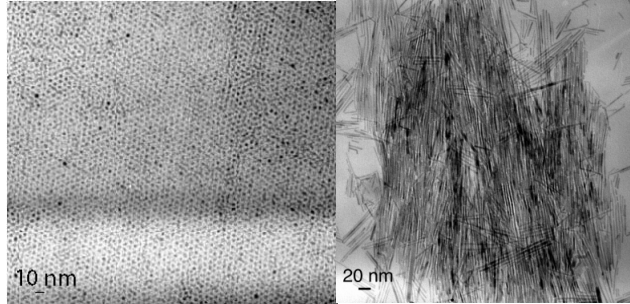


Figure 1: Isotropic ZnO nanoparticles and nanorods

We have studied the emission properties of nanocrystalline ZnO nanoparticles and nanorods prepared following this organometallic synthetic method. We observed a clear influence of the shape of the particles and of the ligands on the luminescence properties in the visible domain. We observed two different emissions at 440 nm and at 580 nm that are associate with the presence of surface defects on the particles. The first one corresponds to the well known yellow emission located at 580 nm with a lifetime of 1850 ns for 4.0 nm size particles. The second emission at 440 nm is observed when amine ligands are present. Based on our optical measurements, we have proposed mechanism at the origin of the two emissions (Figure 2).

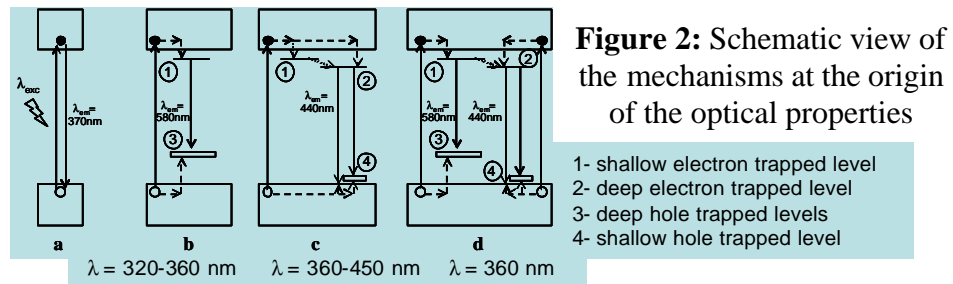


Figure 2: Schematic view of the mechanisms at the origin of the optical properties

We also observed that the modification of the relative intensity between the two emissions is related to a specific location of the amine ligands on the surface of the particles. Interestingly, a selective excitation can lead to observe a yellow, blue or white emission, the latter one corresponding to the sum of the two previous ones (Figure 3).



Figure 3: Emission colours as a function of the excitation wavelength

- [1] M. L. Kahn, M. Monge, V. Collière, F. Senocq, A. Maisonnat, B. Chaudret, *Adv. Func. Mater.* **2005**, *15*, 458.
 [2] M. L. Kahn, M. Monge, A. Maisonnat, B. Chaudret, *French Patent CNRS*, Fr 03-042825 (April 7th 2003), PCT/FR/04/00850 (April 6th 2004).
 [3] M. Monge, M. L. Kahn, A. Maisonnat, B. Chaudret, *Angew. Chem. Int. Ed.* **2003**, *42*, 5321.
 [4] M. L. Kahn, M. Monge, E. Snoeck, A. Maisonnat, B. Chaudret, *Small* **2005**, *1*, 221.