Stability of quantum dot/silica hybrid particles with various morphologies at high temperature and humidity

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We investigate the photoluminescence stability of quantum dot (QD)/silica hybrid particles against high temperature and humidity. Different morphology particles, silica/QD/silica (SQS), QD/mesoporous silica (MSQ), and QD/wrinkled silica (WSQ), were synthesized and dispersed in a silicone resin. We conducted stability tests on these QD containing nanocomposites at 100 °C/85% RH for 72 h, and found that their quantum efficiencies (QE_{film}) were maintained or even increased during the test, whereas a film containing bare QDs exhibited a significant decrease. The increase in QE_{film} of the films containing the MSQ and SQS particles was due to the photoactivation phenomenon of QDs. To elaborate the result of the test, we stored the photoactivated nanocomposites under ambient conditions for 10 days after the exposure, then measured the QE_{film}. Those values decreased to values even lower than the initial. However, QE_{film} of the WSQ particles remained constant during and after the test because of the morphology. We conclude that the film containing the WSQ was most stable against high temperature and humidity and that the photoactivation was not desirable for the stability of QDs.