1 Executive summary

The overall project goal of UVTech was to deliver a new innovative materials processing technology based on exploiting breakthroughs in two fields; the advanced and steadily increasing body of knowledge in, and availability of, chemically-synthesised and size-controlled nanoparticles, combined with new photoprocessing-enabled low temperature chemical reaction pathways. To achieve this goal, the project was focused on the design, synthesis and processing of precursors and nanocrystal-based material clusters, the development of robust photoprocessing-enabled co-deposition protocols for embedded nanoparticles in a variety of host matrices and the validation of this new deposition technology in a number of industrially relevant test platforms. The project did provide proof-of-concept and preliminary industrial validation of this new route to form all inorganic based nanocrystal/host matrix material systems and functional multilayer structures.

The UVTech consortium represented a world-class interdisciplinary research team with leading experts in the fields of excimer lamp-based photoprocessing and low temperature chemical vapour deposition reaction pathways, chemically-synthesised and size-controlled nanoparticles, novel precursor design and synthesis, mathematical modelling and simulation of CVD processes combined with expertise in the integration of new multifunctional materials in microelectronic, sensor and photonic technologies for new product development. The consortium was vertically integrated with a precursor materials supplier (*SAFC*), a basic research university with expertise in photoprocessing (*UCL*), two national research institutes (*UCC-TNI and CEA-LETI*) with expertise ranging from nanoparticle synthesis to technology device demonstration, a consulting company with specialist expertise in simulation of CVD processes (*IPM*) and two Tier 1 multinational end-users already incorporating nanotechnology-enabled materials into products from the automotive and microelectronics industrial sectors (*FIAT and ST*). Although ST withdrew during the project, they still maintain an interest through their collaborations with CEA In addition, the consortium interacted with a leading European process equipment supplier with expertise in novel reactor design and development.

Key achievements to-date include: Novel silicon and platinum nanocrystal synthesis route developed; New precursor solutions developed; Low temp 330C photoenhanced deposition of dielectrics demonstrated; Design of novel deposition system completed and transferred to equipment manufacturer; Low temperature CVD oxide deposition process demonstrated, and finally, successful demonstration of UVTech proof-of-concept with nanoparticles and host matrix material co-deposited in a single process step. Unfortunately, as the project progressed it was realised that the number density of the nanoparticles was too low for the practical applications envisaged. The problems encountered at UCL when attempting to increase nanoparticle density in films were also observed at TNI using different deposition technologies to a large degree. However, the significant effort at TNI in the later stages of the project to investigate numerous variants of precursor introduction and CVD conditions provided some hope that a vapour phase process may be possible of delivering the targeted layer composition in the future. Even so, a number of

combinations of host films and nanocrystal species were realised. The UVTech project has developed a number of host precursors and nanocrystals (with stabilisation) together with developed designs for various evaluation platforms. The low nanoparticle density meant that the demonstrator platforms, designed in the course of the project, could not be realised at this stage.

With respect to positioning of UVTech vis the international state-of-the art; to-date, a co-deposition route to simultaneously forming all inorganic based nanocrystal / host matrix material systems and functional multilayer structures, combining chemically synthesised nanoparticles and UV assisted liquid CVD injection has not been demonstrated. The demonstration of the proof-of-principle of the UVTech approach this year and its intellectual property protection, maintains the UVTech consortium's current advance over competing international groups.

The initial exploitation routes are build into the consortium composition; a precursor materials supplier *(SAFC)* and two Tier 1 multinational end-users already incorporating nanotechnology-enabled materials into products from the automotive and microelectronics industrial sectors *(FIAT and ST)*.