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Development of a novel multifunctional bioglass-based coating for the next generation of prostheses

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Promethean Particles is a UK-based SME that designs and develops inorganic nanomaterials in liquid dispersions. The company's technology is based on a patented reactor design that allows truly continuous hydrothermal (or solvothermal) synthesis of inorganic nanoparticles [1]. Promethean use small scale reactor systems for rapid prototyping to tune the optimum product for each application and backs this up with pilot-scale production facilities, as well as a multi-ton scale nanoparticle manufacturing plant (capacity more than 1000 tons per year), see figure 1.a. Our unique production process allows us to tailor the nanoparticles to get the best functionality for an end use application. Innovation is a large focus of our business, as a direct outcome of our R&D activities. We are currently active partners in three Innovate UKfunded projects and four EU-funded Horizon 2020 projects. One of our Innovate UK projects aims to develop a novel multifunctional bioglassbased coating for the next generation of prostheses. The cost of implant failure can be massive, both financially for medical services (€ 800 m/year in Europe alone in 2010 for dental implants) and personally to the patient where amputations can be life altering. Bioglass-based coatings can help bone integration of the implant and reduce these costly infections from occurring.

Due to the versatility of our lab-scale technology, we are able to tailor bioglass-based materials using different components and with dopants such as ZnO and Cu. We have achieved excellent control over the ratio of components, the particle size within an amorphous matrix (see figure 1.b-c) and the solid phase. Further tests have been performed by our partners Johnson Matthey (JM) and Queen's Mary University London (QMUL). Our bioglass-based materials are used by JM to coat substrates which are then tested by QMUL to investigate their biocompatibility and antimicrobial properties. Within this project, our Bioglass-based materials are demonstrating promising antimicrobial activities.



Figure 1. (A) Promethean's multi-ton scale nanoparticle manufacturing plant (capacity more than 1000 tons per year),(B) SEM image of a bioglass-based material.

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