**Project No:** 624318

**Project Acronym:** MemSense

**Project Full Name:** Microcavity Array Supported Lipid Bilayers; Biomimetic Test Beds for Drug‑Membrane Interactions

1. **Publishable Summary**

The key goals of the research project were; development of state of the art, optimised plasmonically directed nanostructured arrays which will lead to the production of a novel drug-membrane permeability assay which provides a diffusion coefficient value for a range of drugs interacting with different membranes. Ultimately the aim was to produce and provide a platform/assay for assessing membrane permeability which can be utilised in drug discovery to facilitate the selection of appropriate targets earlier in the pipeline. This goal will save time and money in the development of important drugs and not only benefit EU pharmaceutical companies but patient’s right across Europe.

This is the first and final technical report for this project, completed 8 weeks after commencement of the workprogramme.

Overall, the workprogramme had been proceeding according to schedule;

Initial work to begin production of standard microcavity arrays was carried out. Iain was provided with training on the preparation of the cavity arrays and had begun to prepare the arrays independently. These were to form the basis for the subsequent plasmonically directed arrays, an essential component of this project and a significant step forward in the current state-of-the-art.

Iain spent some weeks learning to use COMSOL and had commenced the computational studies to investigate where the plasmonic fields would be strongest and nanoparticle growth would occur under irradiation in the cavity structures. Initial theoretical investigation of the effect of metallic structures would have on the subsequent field enhancements was also commenced. This was an essential part of the work to inform future experiments. The computational studies had started to yield useful insights into predicted positioning and shapes of the plasmonically directed structures. Additionally, the control of; polarization, illumination direction and illumination properties such as wavelength etc. within the software indicated potential control that can be gained over the plasmonically directed structures when careful control is exerted over the illumination source used for the growth of these structures.

The expected final result was the production of an optimised microcavity array with additional plasmonic features that allow the positional control of the enhancement field and thus produce a more active array (with respect to field enhancements) for the study of drug-membrane interactions that can be monitored by enhanced optical vibrational spectroscopy.

1. **Project Objectives For The Period**

Objectives for months 0-2 as set out in the proposed work plan included the preparation of conventional cavity arrays. The first deliverable; preparation of a range of gold and gold over silver microcavity arrays with and without plasmonically directed nanostructures over the whole array and only within the cavities, was not due for completion until month eight. However, work towards this larger deliverable was on schedule within this reporting period.

1. **Work Progress and Achievements During The Period**

* Progress towards objectives

The fellow given detailed instruction on the preparation of the conventional cavity arrays and had started to work on their production independently. He spent the first three weeks reading the literature, and developing his workplan and identifying the best materials for use in depositing the plasmonically grown structures.

To aid the initial and subsequent objectives he also learnt how to use the modelling environment COMSOL and studied the effect of different cavity geometries and illumination parameters on the structures that can be expected to be plasmonically grown in different setups. This has provided numerous promising leads and will hopefully minimise the trial and error experiments that would be required to identify suitable parameters for the growth of different structural motifs on the standard microcavity arrays.

* Researcher training activities

The majority of Iains short time with our group was spent studying, i.e. to update and familiarise himself with the current state of the art and receiving in-house training on cavity preparation. He was also provided with initial training on some of the spectroscopic instrumentation required for the project. The Fellow also learnt how to model in the multiphysics environment of COMSOL. He started from a position of never having used this software before but got to grips with it quite quickly and managed to start to produce some useful insights which would have been used in objectives and deliverables within the overall research project, had the project continued.

* Resources

With respect to use of resources and researcher-months the time spent on the project has been closely aligned to the proposed plan.

1. **Additional Information**

Very disappointingly, the fellow resigned his fellowship approximately 4 weeks into the programme. He informed me that he was leaving to take up a permanent post in the UK and that the reason he had decided to do this was that, having been out of academia for several years, he had forgotten the level of commitment and sacrifice required to be successful in this field. He did not think the benefits outweighed the sacrifice and so he had decided to return to an administrative position which he had been offered on a permanent basis.

**Dissemination Activities**

N/A

1. **Project Management**

The project was managed according to the workprogramme with biweekly meetings and additional individual planning meetings between supervisor and fellow.

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1. We have included a group rather than project website as we were only commencing set up of the web site when Iain left and so this has not been completed.