Executive Summary of "Developing Low-Cost, Portable, Integrated OCT Systems Using Low-Loss Silicon Nitride Platform"

Optical coherence tomography (OCT) is a non-invasive imaging modality that provides depth-resolved, high-resolution images of tissue microstructures. Every year, more than 30 million OCT scans are performed all over the world. It has become the de facto diagnostic and monitoring tool for ophthalmic diseases, and an emerging imaging technology in other areas such as dermatology, gastroenterology and breast cancer imaging. However, the cost of an OCT system is typical from tens of thousands of dollars to easily exceeding $100,000, the size of an OCT system could be on the order of meter cubic, the parts in the OCT system are separated and need to be actively aligned. The cost, the size and the misalignment of the parts are prohibitive these powerful imaging systems to all but the busiest and most sophisticated practices.

We plan to develop a prototype for a low-cost, portable, integrated OCT system based on silicon photonics, more specifically low loss Si_3N_4. The light source, interferometer and spectrometer of the OCT system will be independently developed and then integrated onto the same carrier to ensure the success of the project. The integration of light source will be developed and achieved through two approaches in parallel: i) The higher risk but higher degree of scalability and integration approach - gain chips and Si_3N_4 resonators based frequency combs. ii) The lower risk and more conventional approach - SLD diode and Si_3N_4 photonic chip co-package. The integration of the interferometer will be based on the low loss Si_3N_4 platform, the reference arm will have a length that is long enough to match the path length of the sample arm. The sample arm will be miniatured using a co-packaging process with MEMS scanners. The integration of the spectrometers will also be based on Si_3N_4 platform and achieved through two approaches in parallel i) The stationary FTS with a Si_3N_4 grating. ii) Si_3N_4 AWG with lenses integrated on the edge of the chip. All these components will be developed around a central wavelength of 1050 nm, and retinal scans will be taken with our system in collaboration with OCT experts also at Shanghai Jiao Tong University.

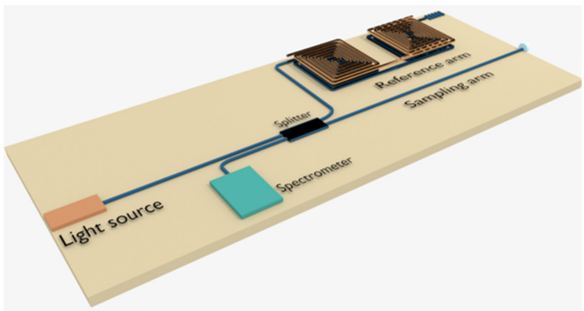

Fig. 1. Schematic of proposed OCT system. All three core parts of the OCT system (light source, interferometer, spectrometer) are miniatured and integrated on the same carrier.

The outcome of our proposal is expected to be **a prototype of a low-cost, portable, integrated OCT system**. The device we envision, in final form, will be **two orders of magnitude** reduction in price and **several orders of magnitude** reduction in size and weight. It will have the size and weight less than a typical mobile phone, and will have the capability of providing retinal scans at a resolution of less than 10 μm, comparable to midrange clinical devices currently on the market. The schematic of the OCT system is shown in **Fig. 1**. All three core parts of the OCT system are miniatured and integrated on the same carrier using components and technologies developed in this project.

We expect our systems could be further adapted for imaging and diagnosis of diseases in other specialties using different wavelengths as well, especially in dermatology, dentistry and oncology. Our results will help to reduce costs of the health system while increasing accessibility and compliance for better disease management. We hope that the components and the technologies we developed in this project will help pave the way for low-cost, portable OCT systems and incorporating integrated photonics into optical imaging technologies.