Diagnosis and therapy of precocious tumors with inkjet-printed mesoporous silica microdots


1Laboratoire de Science des Procédés Céramiques et de Traitements de Surface, UMR CNRS 7315, CEC, 12 r. Atlantis, 87068 Limoges
2Homéostasie Cellulaire & Pathologies, EA 3842, 2 r. du Dr. Marcland, 87025 Limoges
3Laboratoire de Chimie des Substances Naturelles, UPRES EA 1069, 123 av. A. Thomas, 87068 Limoges
4Institut des Biomolécules Max Mousseron, UMR 5247, 15 av. C. Flahault, 34093 Montpellier
5Institut Charles Gerhardt Montpellier, UMR 5253, pl. E. Bataillon, 34095 Montpellier
6Institut Néel, UPR 2940 CNRS/UJF, 25 rue des Martyrs, 38042 Grenoble
7Kamax Innovative System, 12 r. Gémini, 87000 Limoges
8Xlim, UMR CNRS 7252, 123 av. A. Thomas, 87060 Limoges

Cancers represent a major health challenge in the world. Early detection of tumors is advantageous for treatments efficiency. Consequently, new biotechnologies are focusing on a way to solve that disease. In 2011, a study has been initiated at the SPCTS laboratory, in order to develop an endoscopic device suitable for early detection and treatment of tumors [1]. At first, this device is to be used for lung and bowel cancers, and for breast and prostate cancers with time.

Inkjet Printing (IJP), combined with Evaporation Induced Self-Assembly (EISA), affords to produce mesoporous silica microdots arrays that can be specifically functionalized by click chemistry [2].

For the diagnosis, bio-receptors are labeled with appropriate fluorophores and anchored to the microdots surface. When interacting with the specific cancerous biomarkers on tumor cells, a conformation change of the bio-receptors occurs, and the fluorophores get closer. Consequently, a Fluorescence Resonance Energy Transfer (FRET) occurs and is spectrally detected by confocal laser microscopy. The functionalization with labeled bio-receptors affords a specific detection of cancerous biomarkers, as an identification technique for different types of tumors.

Once the diagnosis is effective, the endoscopic device can be upgraded with therapy function. On that purpose, the mesoporous silica microdots are specifically functionalized with photosensitizers, by click chemistry. A laser source is used to excite the photosensitizers, producing singlet oxygen that leads to apoptosis of tumor cells, by PhotoDynamic Therapy (PDT). Such a treatment technique is favorable concerning non-invasive aspects, compared to other existing techniques.