

Title : On The complex interaction between Proteins and Light

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Abstract : For the past decade we have worked on the effects that UV light has on protein structure and function. We have realized that even very weak illumination may disrupt one or more disulphide bridges in the protein rendering them available for further reactions, such immobilization to a surface that is chemically modified with SH groups. Using this approach, we have been able to make protein biosensors with a spot size of a few microns, and a pitch of 10 microns with very simple means. The immobilized protein remain active after immobilization. We estimate that about half of all proteins will have the necessary structural features allowing for the immobilization process. Using flash photolysis, we have studied in detail the ultrafast processes that the UV photon induces in the protein, which eventually lead to the SS breakage. The initial step is ionization of an aromatic residue (TRP or TYR) , followed by solvation of the released electron, which then is available for SS reduction. For some medically relevant receptor protein's such as EGFR (epidermal growth factor receptor) it has become clear that UV illumination equivalent or less than the solar UVB output is sufficient to block the receptor interaction with its ligand. EGFR is dramatically overexpressed in a wide range of cancers, and is often the target for chemotherapeutics. We are now investigating whether this could complement existing methods for cancer therapy. In recent months the Medical Photonics laboratory has received two large EU Horizon2020 grants where our task is to utilize light to immobilize sensor proteins as well as modified DNA onto sensor surfaces. I will briefly allude to the targets of these projects.

Papers relevant for the lecture :

1 Olsen, B. B., Neves-Petersen, M. T., Klitgaard, S., Issinger O.-G. and Petersen, S. B., "UV light blocks EGFR signalling in human cancer cell lines," International Journal of Oncology 30(1), 181-185 (2007).

2 Coutinho I., Correia M., Thiagarajan V., Gajula G.P., Petersen S.P., Neves-Petersen M.T. "Photonic cancer therapy: modulating cellular metabolism with light" Paper 8568-5, Proceedings paper, SPIE Photonics West 2013.

3 Modulating the Structure of EGFR with UV Light: New Possibilities in Cancer Therapy

Correia, Manuel; Thiagarajan, Viruthachalam; Coutinho, Isabel; et al.

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4: Correia M, Neves-Petersen* MT, Jeppesen PB, Gregersen S, Petersen SB (2012). "UV-Light Exposure of Insulin: Pharmaceutical Implications upon Covalent Insulin Dityrosine Dimerization and Disulphide Bond Photolysis". PLoS ONE 7(12):e50733.doi:10.1371/journal.pone.0050733