Journal of Sensors
Volume 2008 (2008), Article ID 797436, 10 pages
doi:10.1155/2008/797436

Research Article

Monitoring of Enzymatic Proteolysis Using Self-Assembled Quantum Dot-Protein Substrate Sensors

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Received 9 May 2008; Accepted 28 June 2008

Academic Editor: Francesco Baldini

Abstract

We have previously utilized hybrid semiconductor quantum dot- (QD-) peptide substrates for monitoring of enzymatic proteolysis. In this report, we expand on this sensing strategy to further monitor protein-protease interactions. We utilize QDs self-assembled with multiple copies of dye-labeled proteins as substrates for the sensing of protease activity. Detection of proteolysis is based on changes in the rate of fluorescence resonance energy transfer (FRET) between the QDs and the proximal dye-labeled proteins following protein digestion by added enzyme. Our study focused on two representative proteolytic enzymes: the cysteine protease papain and the serine protease endoproteinase K. Analysis of the enzymatic digestion allowed us to estimate minimal values for the enzymatic activities of each enzyme used. Mechanisms of enzymatic inhibition were also inferred from the FRET data collected in the presence of inhibitors. Potential applications of this technology include drug discovery assays and in vivo cellular monitoring of enzymatic activity.