Non-Contact Luminescence Lifetime Micro-Thermometry Using Scintillation Sensors

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Temperature is a critical parameter that defines the state of any system in the nature. Measuring temperature accurately and reliably is thus very important when monitoring chemical, physical and biological processes. For example, knowledge of the precise sample temperature is of high importance in reducing radiation damage to protein crystals during X-ray diffraction experiments using intense synchrotron radiation. A novel technique for remote, non-contact monitoring of the protein crystal temperature has been developed for the new I23 beamline at the Diamond Light Source, a facility dedicated to macromolecular crystallography (MX) with long-wavelength X-rays [1]. Conceptually the method is based on the measurements of the variation of the decay time of a scintillation crystal with temperature. The possibility to have a submicron size sensor in the close proximity to the sample under test and the contactless readout of the signal are the main appealing features of this method.

In this talk we first describe the features of the technique starting with a brief introduction of the measurement principles. We will discuss the characteristics of the components, including choice of scintillation sensors, and practical implementation of the system in the suite of beamline instrumentation. The system performance and application examples will be described and discussed using application examples to demonstrate the potential of the developed technique for non-contact, *in situ* measurements of cryogenic temperatures.

[1] A. Wagner et al., *Acta Cryst. D* **72** (2016) 430-439.