Luminescence thermometry - crossing the limits of operating range

Temperature is a thermodynamic parameter that controls the dynamics and life span of virtually all natural and engineering systems at the macro- and microscopic levels. Its precise, uninterrupted, and reliable measurement is crucial for all fields of science and biology. It appears that at present temperature sensors constitute about 80% of the global sensor market, whose value according to forecasts by Grand Viev Research is to amount to USD 6.82 billion by 2023. However, temperature measurement by conventional methods is not always possible, and it can also be affected by large inaccuracy. Contact thermometers are ineffective in situations where it is required to work in difficult conditions (inside turbines, engines), moving objects (gas streams), as well as when the size of the measured system is of the order of micrometers, or even smaller (biological, microelectronic systems). Due to these limitations, current technologies have reached a point where the use of conventional contact thermometers is increasingly ineffective and this problem will continuously grow with the development of technology. Non-contact temperature sensors that are able to meet the requirements of modern technologies are considered the most promising alternative.

Currently, optical methods are being investigated for use in new types of temperature sensors, among others in thermography, Raman scattering, thermal reflection and luminescence. Among them, luminescence-based thermometry turns out to be a very promising alternative. The luminescent thermometry technique offers the opportunity to overcome some limitations of another non-contact temperature sensors, e.g. pyrometry, and can even bring new benefits. It provides continuous readout in real time, gives real chances for high spatial and temperature resolution, while being insensitive to electromagnetic fields or other interferences. **Nevertheless, at the moment, the vast majority of luminescent temperature sensors operate in relatively narrow temperature ranges, which usually reach no more than 250 °C.** This is due to the fact that luminescent materials often lose their properties at elevated temperatures, which is associated, among others, with the phenomenon of temperature quenching of luminescent centers or the sensitivity and instability of the materials used to high temperatures. **The design of efficient luminescent thermometers, which can work in a wide temperature range, is attractive for many industrial applications, especially when the scope of work includes high temperatures of many technological processes (> 600 °C).** Such thermometers would be of a great interest in the aviation industry and space research improving the safety and reducing the costs, simultaneously**. We believe that using our approach, presented in this project, it is possible to design a luminescent thermometer operating in the range of 4-1000 K, and maybe even wider, with high sensitivity and high precision temperature measurement.** This would be real breakthrough in the field of luminescence thermometry.