Light-modulated ion binding: Towards calibrationless sensors

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Emerging technologies create new application fields but few of them require that we completely rethink our approach in preparation and characterization of sensors. The vision of internet scale wireless sensor networks (WSNs) requires the deployment of enormous numbers of sensors. This necessarily means that the cost of each sensor must be brought down significantly if this vision is to be realized.

An ideal solution for this problem would be a sensor that does not interact with its environment in any way until there is a need for measurement. Upon the measurement, the sensor's surface is completely regenerated and returned into the state as before the measurement. This step is critical as it ensures that the measurement did not **any** effect on the sensor hence no calibration is necessary.

In our work, we use compounds that indeed can be switched between the active and passive state using light. Most commonly used compounds are so called spiropyrans (SP) and spirooxazines (SO). Here we show the recent advance in preparation of reversible, light-modulated sensors using surface immobilised SP/SO derivatives. A further attractive property of these materials is that they are inherently self-indicating through striking colour changes that enable the state to be easily determined (active vs. passive), and the presence of a bound guest to be detected. These spectral changes enable a range of self-diagnostic tests to be incorporated that enable binding events to be controlled at the surface interface, and for real binding events to be distinguished from artefacts arsing from changes in light intensity, or photobleaching of the active component. We have identified most notable problems for utilization of these compounds in "calibrationless" sensors such as relatively weak binding constants, photodegradation, and unfavourable kinetics of switching between the active and passive state and we demonstrate our approach in solving these problems.