Measure Your Mood in a Matter of Seconds

A popular science summary of the Master's thesis:
Neurotransmitter MIPs for the potential use in amperometric sensors

By Axel Rüter

The common ways of measuring different analyte concentrations in the human blood are often based on antibodies. These biomolecules possess the best chemical recognition known and can easily distinguish friend from foe. Their perfection does however come at a very high price. Molecularly imprinted polymers (MIP) are a way around this. Easily chemically produced and much cheaper, these artifical antibodies can be incorporated in simple electrochemical devices for fast and precise concentration measurements, hopefully revolutionising the field of medical analysis.

Serotonin is a neurotransmitter known to regulate people's mood and hunger. Too low levels inside the brain could be an indication of depression or different anxiety syndromes. Treatment of such diseases are performed with medication altering serotonin levels and are therefore dependent on methods determining said concentrations. To measure serotonin levels today a blood sample is required. The sample will then be submitted to time demanding and sophisticated methods to determine the result. Faster, cheaper and easier concentration determination methods could provide better and more accurate health care and reduce the risk of overmedication.

The concept for my thesis was a small device, much like a glucose meter, that could deliver the accurate serotonin concentration from a drop of a body fluid in a matter of seconds. Such a device would be realised using MIP technology. Unfortunately no successful artificial antibodies were synthesised for serotonin during the time frame of the project, regardless of intensive troubleshooting. The reason behind this is still a mystery. The similar but different molecule histamine was instead targeted with good results. As for the matter of incorporating the MIPs into a sensor device. This was not as straight forward as was hoped for.

Molecular imprinting can be described with a lock and key analogy. A lock is produced that only fits one specific key. Instead of the lock there is a polymeric material synthesised by the means of organic chemistry, and instead of the key, there is a molecule which is to be analysed.

Before the synthesis can start the molecule of interest, also called the template (T), has to be chemically paired to the building blocks of the polymeric matrix, also called functional monomers (M). This paring process relies on weak chemical bonds created between T and M and the more they are, the stronger and more specific their interactions will be. After this step, referred to as self-assembly, a cross-linker (CL) is added to the mixture and polymerisation glues everything together to a hard and stable matrix. The template, still inside the polymer, is removed to exhibit empty binding sites. Now the polymer can be further tested or incorporated in an application. The synthesis process is schematically shown in Figure 1.

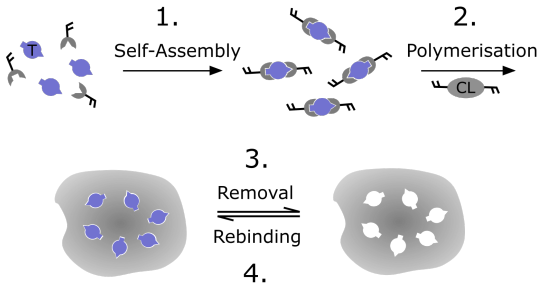

Figure 1: A schematic image showing the molecular imprinting process. *Template molecules (T) are let to self-assembly with functional monomers. Through the addition of a cross-linker (CL) and polymerisation a stable polymer matrix is produced. The template is removed before the MIP is submitted to further testing.*

For a working serotonin measuring device there is still a long way to go. The molecular imprinting process is delicate and the demand for high specificity in relevant conditions still requires optimisation studies. The process of MIP immobilisation and the actual sensor device also need further investigation for accurate and reproducible results. Hopefully there will eventually be a cheap and accessible way to more or less determine your mood. Probably not available for the private consumer, it would however help doctors everywhere to perform more precise and personalised care of patients suffering from example depression.