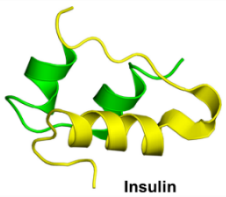
Diabetes mellitus, also simply called **diabetes**, is a group of metabolic disorders related to elevated glucose blood levels. This is one of the most widespread worldwide diseases. That is, in 2014 there were 422 million cases of diabetes, constituting 8.5% of the adult population in the world. In 2019, it was the direct cause of 1.5 million deaths. Moreover, diabetes leads to elevated blood pressure and increased risk of heart attacks and strokes. Accumulation of small blood vessels damages causes diabetic retinopathy and, finally, blindness. Similarly, reduced blood flow combined with neuropathy may result in "diabetic foot syndrome" that may lead even to limb amputation. The blue circle is recognized as worldwide symbol of diabetes.

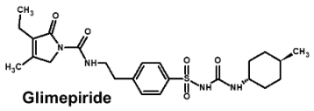
There is no single cause of diabetes. Therefore, several different types of diabetes are distinguished. **Type 1 diabetes**, also known as insulin-dependent, is an autoimmune disease. T-cells mediated attack of the immune system to beta cells of the pancreatic islets leads to their deterioration and insufficient insulin production in patient's body. **Type 2 diabetes** is caused by **insulin resistance**. That is, in this case, insulin, even if produced by the pancreas is ineffective in reducing glucose blood levels. Under this condition, insulin levels may be both increased as well as decreased. Type 2 constitutes the majority of diabetes cases. **Gestational diabetes** occurs when a pregnant woman develops high glucose levels. In some cases, it leads to type 2 diabetes. **Maturity-onset diabetes of the young** (**MODY**) is a rare autosomal dominant genetic disease.

This illustrates how vital are diabetes diagnosis and proper treatment. The most important parameter in diabetes diagnosis is controlling the blood glucose levels, which is already solved. Numerous handheld/portable sensors, namely glucometers, are already on the market. These devices enable regular controlling of glucose blood levels by patients at home, by themselves. However, glucose is not the only biomarker that should be monitored in diabetes patients. Therefore, within this Project, we propose to devise sensors for selective determination of **insulin**, **peptide C** (a side product of insulin production), and **glimepiride (**anti-diabetic drug).


Insulin

H-Glu-Gly-Glu-Asp-Gly-Gln-Val-Gly-Gln-Gly-Glu-Leu-Gly-Gly-Gly-Pro-Gly-Ala-Gly-Gly-Leu-Gln-Gly-Leu-Ala-Leu-Glu-Gly-Gly-Gly-Gln-OH

Peptide C


Glimepiride

- **Insulin** primary function is to increase glucose uptake by cells and glycogen synthesis. However, it also increases the synthesis of fat and proteins. Moreover, it has an influence on numerous processes in the human body. Insulin is injected into patients with diabetes, especially those with type 1 diabetes. However, not in every case of diabetes, it is necessary. What is important, insulin overdosing may cause dangerous hypoglycaemia (low blood glucose) in patients. It may cause loss of consciousness, seizures, or even death. Therefore, control of insulin blood levels would be beneficial for both diabetes diagnosis as well as for establishing correct treatment.
- **Peptide C** is a side product of insulin biosynthesis. It is secreted simultaneously with insulin in an equimolar ratio. Therefore, monitoring peptide C levels will enable us to track the efficiency of insulin biosynthesis by the pancreas, even in patients treated with synthetic insulin injections.
- **Glimepiride** is an illustrative example of a whole family of sulphonylureic drugs administrated to diabetic patients. This drug decrease glucose blood levels. Overdosing, especially connected with inadequate diet, may lead to dangerous hypoglycemia. Therefore, a sensor for glimepiride would be helpful to develop a proper dosing schedule and diet for diabetic patients.

Within this Project we will propose new class of selective chemosensors based on molecularly imprinted polymers (MIPs). MIPs in form of thin films or nanoparticles (NPs) will be deposited on the gold surface of surface plasmon resonance (SPR) spectroscopy chips. Moreover, SPR spectrometer will be combined with electrochemical cell. Therefore, changes of SPR signal accompanying electrochemical processes will be recorded and used as an analytical signal.

There have been numerous examples of selective electrochemical and optical chemosensors reported so far. However, combining electrochemical experiments with surface-plasmon resonance (SPR) spectroscopy for sensors fabrication is novel and still only a little-explored field. What is important, most up to now reported E-SPR (electrochemically assisted SPR) sensors show only limited sensitivity.

Application of MIPs in the form of thin films nor NPs as selective recognition units **in E-SPR** sensors **is not reported yet**. Even more, an application of **redox-active MIPs in E-SPR** will add additional **novelty to this Project**. Moreover, imprinting of two out of three target molecules, peptide C, and glimepiride, is not yet reported.