Alzheimer's disease (AD) is the most common cause of dementia. More than 10% of people aged 65 and older are affected by this disease, and due to the lack of effective treatment, this number could triple in 2050. In the early stages, patients forget familiar words and names, the location of their personal objects, or information that was just heard or read. Then, the symptoms gradually worsen. In the middle stage of AD, patients do not remember personal stories and events, quickly get frustrated and angry, and need assistance in routine tasks. The late stage is associated with difficulties in communication and expressing their feelings and troubles with eating, using toilet, and during the bath.

Amyloid plaques are one of AD's characteristic hallmarks. They consist of aggregated amyloid beta peptides (Aβ peptides) with a high content of copper ions. The elevates level of oxidative stress has been also observed for AD patients. Thus, numerous studies have been launched on the oligomerization of Aβ, their interaction with copper ions, and the potential role of Cu/Aβ complexes in the production of Reactive Oxygen Species (ROS). Despite this, the clinical trials on drugs aimed at these molecular targets remain far from the expected success.

However, the previous results were focused on $A\beta_{1\text{-}40/42}$ peptides, whereas there is a huge diversity of Aβ peptides in the brain, including the peptides truncated at the N-terminus, such as $A\beta_{4\text{-}x}$ and $A\beta_{5\text{-}x}$. Their concentration in the brain (as for $A\beta_{4\text{-}x}$) could be as high as that of $A\beta_{1\text{-}x}$, but their activity related to Cu(II) complexes are completely different. For example, the stability of Cu(II) complexes of $A\beta_{4\text{-}x}$ and $A\beta_{5\text{-}x}$ is much higher than that of Cu(II)/$A\beta_{1\text{-}x}$ and the level of ROS is much lower in the presence of Cu/$A\beta_{4\text{-}x}$ or Cu/$A\beta_{5\text{-}x}$ than Cu/$A\beta_{1\text{-}x}$.

The aim of this project is to describe the influence of phosphorylation of amyloid beta peptides on the redox activity of their copper complexes and aggregation. Considering the diversity of Aβ peptides at the N-terminus, we plan to synthetize a series of Aβ peptides phosphorylated at Ser8. The phosphorylation at Ser8 (which is in the close proximity to Cu(II) binding sites) has been observed for biological samples of brain tissues of AD patients. We will employ electrochemical techniques to study the effect of the phosphorylation of Aβ peptides on the redox activity of their copper complexes. Then, we will investigate how the phosphorylation affects the ROS production by Cu/Aβ complexes. Finally, we will perform aggregation experiments to investigate how phosphorylation affect the formation of Aβ assemblies in the presence of copper ions.

The results of those studies allow us to describe the influence of Aβ peptides on two main processes related to AD, the elevated level of oxidative stress and aggregation of Aβ peptides. Thus, they could be of great interest for future therapies against AD.