The kinetics of aggregation of the Aβ_{1-40} peptide monitored by magnetooptical methods

Marceli Koralewski,[1] Małgorzata Paprzycka,[1] Katarina Siposova,[2] and Oskar Sobotka[1]

[1] *Faculty of Physics Adam Mickiewicz University in Poznań, Uniwersytetu Poznańskiego 2 61-614 Poznań, Poland;*
[2] *Department of Biophysics, Institute of Experimental Physics Slovak Academy of Sciences, Watsonova 47, 040 01 Košice, Slovak Republic*

Protein misfolding leads to the formation of amyloid fibrils and causes many serious diseases affecting millions of people worldwide [1]. In the presented study we used magnetooptical (MO) methods such as Faraday and Cotton-Mouton [2] effects (FE and CME respectively) to monitor the aggregation processes of one of the most studied peptides, amyloid β_{1-40} (Aβ_{1-40}) which is associated with Alzheimer's disease. Especially CME is very sensitive to the shape (through the anisotropy of optical polarizability and magnetic susceptibility) of the studied species which allows us to monitor their changes. The impact of time (up to 30 days) and storing temperature (8, 23, 36 °C) on the aggregation of Aβ_{1-40} was evaluated by calculations and modeling the measured coefficients that describe both effects. In addition, the time-dependent kinetic profile of Aβ_{1-40} amyloid aggregations has been monitored using Thioflavin T fluorescence assay and the morphology of mature Aβ_{1-40} fibrils was visualized by atomic force microscopy. As expected, CME, proved to be more suitable for monitoring protein aggregation than FE and, thus using a compact magnetopolarimeter, it could routinely be applied without any additional chemical procedure in biomedical studies. In addition, CME has been successfully used by us to demonstrate the self-assembly of phenylalanine which is considered as the most important amino acid in understanding the aggregation process of Aβ_{1-40}.

References:

[1] Chen, Gf. et al., Acta Pharmacol Sin 38, 1205–1235 (2017). https://doi.org/10.1038/aps.2017.28
[2] Koralewski M. et al., ACS Appl. Mater. Interfaces 10 (9), 7777-7787 (2018). https://doi.org/10.1021/acsami.7b18304

This work was supported (to KS) by research grants from the Slovak Grant Agency VEGA (No. 2/0034/22) and SAS-MOST/JRP/2021/192/AZCAI.