Secondary caries is one of the main issues of restorative dentistry. Its mechanism is exactly the same as all other types of caries. In general, caries is the result of bacterial acid attack on hard tooth tissues. The difference is in the place of occurring. Secondary (recurring) caries appears between the remaining tooth walls and the dental filling. If the preparation procedure is carried out properly, i.e. the entire caries lesion is removed before placing the restorative material inside the cavity, then it seems that the appearance of secondary caries is related to the failure of restoration. If the restoration does not adhere closely to the cavity walls, then the gaps are formed, bacteria can penetrate the gaps and create the caries lesion. Then, the filling must be removed and replaced by the new one, which is connected with another visit to the dentist and another dental treatment in the optimistic case. In the pessimistic case, the whole tooth deteriorates and, finally, it has to be removed. At the first stage of caries disease, so-called demineralization occurs. Demineralization is based on the removal of calcium and phosphate from the structure of the tooth. However, it can be reversed, as shown in Figure 1, by providing calcium and phosphate to the surface of the tooth from external sources, such as toothpaste or mouth rinse.

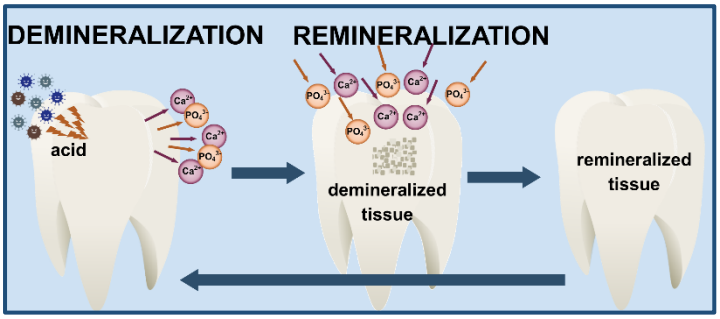

Fig. 1. Schematic diagram of demineralization and remineralization processes

However, popular, these external reservoirs of necessary components show limited application in the battle against secondary caries, as their action is limited to well-available places and last mainly during the exposition. The question is: why not provide remineralizing agents from dental filling that remains in constant contact with places that are prone to secondary caries? A schematic diagram of this solution is presented in Figure 2.

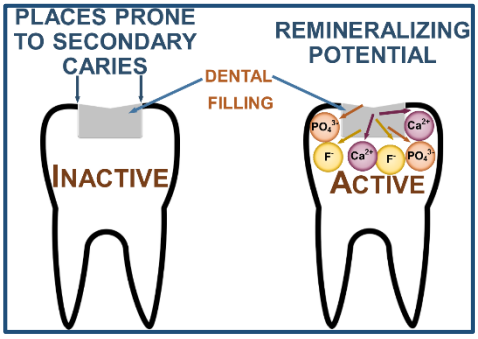

Fig. 2. Schematic diagram of the remineralizing potential of an active dental filling compared to an inactive dental filling

The inactive dental filling (left side) only "waits" passively in the cavity for the action of caries. In contrast, the active dental filling (right side) starts the battle against demineralization by releasing active remineralizing ions (calcium, fluoride, and phosphate) to the tooth surfaces that remain in contact with the filling.

Currently, the most popular dental fillings are unfortunately inactive. There are also so-called glass-ionomer cements, which show an active remineralizing potential. Still, their application is limited to non-stress bearing sites of teeth, as their mechanical properties are weak. This project aims to prepare dental fillings with calcium phosphates particles that are chemically similar to the main component of bones and teeth. Moreover, because they are composed of calcium and phosphate ions and can also incorporate fluoride ions, they show remineralizing potential. Calcium phosphates are indeed very attractive as components of new dental fillings, but research carried out so far has shown that the mechanical properties of experimental dental fillings with calcium phosphates are their most important weakness. Moreover, this desirable remineralizing potential is rather short-lasting. However, all studies were conducted to a very limited extent. The author of this project assumes a significant extension of the conducted research on materials from the calcium phosphates group that have not been thoroughly examined as potential components of novel dental fillings with remineralizing potential. Moreover, to improve the mechanical properties and prolong the remineralizing potential of such perspective fillings, it is planned to conduct different chemical modifications of the surface of calcium phosphates. The proposed modifications in many different variants, as well as their effect on the filling properties, have not yet been examined. Therefore, the research conducted under the project will include the preparation and modification of calcium phosphates, incorporation of calcium phosphates into novel light-cured dental fillings, and examination of the physicochemical, mechanical, and performance properties of the obtained fillings, as well as their biocompatibility and cytotoxicity.