The major difference between metals and molecules is the way electrons are shared between atoms. In the former some electrons are shared by all atoms giving metals their characteristic shine and thermal and electric conductivity. In molecules electrons are usually confined to one or few atoms, if they form bonds. Nano-clusters of metals containing few atoms and of a size of up to 2 nano-meters (1 divided by one million millimeters) represent a class of substances in the limit between metals and molecules. Larger sets of metallic atoms constitute the so called nano-particles, which already show some characteristics of metals. A striking difference when reducing the size of the set of metals between nano-particles and –clusters is the appearance of luminescence. This opens the possibility of using metals for many applications in biology and optical technologies. For many years researchers around the world have been synthetizing new nano-clusters of gold, silver, copper and other metals, and even mixtures of them. A major difficulty is to obtain them pure enough. Even working with the purest compounds there are still many questions to be answered regarding their chemistry and physics. Particularly puzzling is understanding why the absorb light the way they do and why they emit light the way they do. This understanding is important because knowing the reasons, like which energetic states are involved or under which conditions they emit more light, we would be able to design new nano-clusters with the properties required for whichever applications foreseen.

In this project we establish a collaboration with a well reputed group in the field of nano-clusters from the University of Geneva in Switzerland. They are able to produce so called atomically precise nano-clusters and have a large experience in their characterization. From the Polish side, in the Institute of Physical Chemistry of the Polish Academy we have a battery of photo-physical techniques that can help us in unveiling the issues commented above. Particularly, Femto-second Stimulated Raman Scattering is a technique that allows to make relationships between the structural changes suffered by the objects under study, and their photo-physical properties. This way, by performing experiments in pure nano-cluster samples we would be able to determine why and how these compounds absorb and emit light the way the do.