Why we study single chemical molecules? Children in the classroom are similar, have similar age, height, ability, are in similar surroundings, sit in similar benches. In the case of chemical particles, these similarities are even greater. Chemical molecules of one compound are by definition the same. In spite of all, each of them may be in a slightly different position, have a little different neighbor. As children in the classroom, sit either nearer to the board or in the corner of the room. Similarly, chemical molecules, depending on their environment, may behave a little differently. Even a small difference can be important in certain circumstances. When all the children in the class speak at once, we hear only the noise and we cannot understand what they are saying. That is why it is better when each student speaks one by one. In the case of a huge crowd, it is necessary to give such a person a microphone to amplify the strength of his voice. Similarly, we can use some sort of amplifier to amplify signals from selected molecules.

In this project, we want to study single molecules and single nanoparticles by scattering laser light on them. The tiny part of this light can change color. This color change very strictly depends on the physical and chemical nature of the molecule and is characteristic of the chemical. Unfortunately, only an extremely small and impossible to measure the amount of light change the color. On the other hand, it is possible to increase it, that is, in the effect of strengthening, placing near the molecule the corresponding metal nanoparticles. The enhancement process is quite complex and we do not fully understand it yet. That is why we have prepared a series of experiments to understand better how this enhancement works. Our approach based on the observation that single molecules and single nanoparticles do not scatter light equally in all directions. Moreover, the direction in which light would be scattered may depend on the color of this light. A new type of the optical microscope able to register such directional uniformity of the light scattered by nanoobjects will be used for this study. After explaining how we can use this knowledge to create even better amplifiers. The results of this study may help to design tiny light switches, such as those used on CDs and DVDs, but 100 times smaller, allowing you to save 100 times more information on the same surface. Apparently, it will also help detecting single molecules, for example, hazardous substances.