

# Study of an optical salinity sensor based on surface plasmon resonance in the amorphous As<sub>2</sub>S<sub>3</sub> thin film structure

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## Abstract

The conventional surface plasmonic resonance is realized in a composite structure consisting of a gold film deposited on the base of a prism. As it was demonstrate, the structure was performant for applications as optical sensors of various physical values. In this paper was studied the sensitivity of optical sensors based on plasmon resonance for measuring the salinity of aqueous salt solutions. The conventional plasmonic structure proposed by Kretschmann was based on the evanescent wave that occurs at light light reflection. The surface plasmons excitation method was modified by adding thin film of material with high refractive index, such as amorphous arsenic sulfide (As<sub>2</sub>S<sub>3</sub>). The chalcogenide As<sub>2</sub>S<sub>3</sub> film forms plasmonic waveguide, which can maintain several modes of the electromagnetic field. The rutile prism (TiO<sub>2</sub>) was used for coupling the light with plasmons. The considered wavelength was 1550 nm, which is optimal for infrared fiber optic networks. The resonance angles were calculated for several salt concentrations in the range of 20-40%. It was shown that the resonance angle depends on the salt concentration and the shift is enough for resolve salinity of different concentration. It was established that the sensitivity depends on the film thickness, the highest being for the thickness of 1000 nm.

Rezonanta plasmonica de suprafata realizata intr-o structura ce consta dintr-un film din aur depus pe baza unei prisme a demonstrat performanta pentru asa aplicatii pentru senzori optici de diverse marimi fizice. In lucrare s-a studiat sensibilitatea senzorilor optici bazati pe rezonanta plasmonica in masurarea salinitatii unei solutii apoase de sare si influenta temperaturii asupra unghiului de rezonanta.

Structura plasmonica conventionala propusa de Kretschmann si care este bazata pe unda evanescenta ce se produce la reflectia totala a luminii ca metoda de excitare a plasmonilor de suprafata a fost modificata prin adaugarea unui film subtire din material cu indice de refractie mare, cum este sulfura de arsen ( $\text{As}_2\text{S}_3$ ) amorf. Filmul prezinta un ghid de unda plasmonic care mentine mai multe moduri ale campului electromagnetic, in cazul de fata din domeniul infrarosu.

Pentru cuplare s-a examinat folosirea unei prisme din rutil ( $\text{TiO}_2$ ). Lungimea de unda considerata este de 1550 nm, optima pentru retele existente cu fibra optica. S-au calculat unghiurile de rezonanta pentru cateva concentratii de sare in domeniul 20-40% si deplasarea acestora functie de concentratie. S-a stabilit ca sensibilitatea depinde de grosimea filmului, cea mai mare fiind pentru grosimea de 1000 nm.