

# INFLUENCE OF THE ENVIRONMENT ON THE COUPLED METAL NANOWIRE PLASMON RESONANCES

N. P. Stognii<sup>1</sup>, N. K. Sakhnenko<sup>1,2</sup>

<sup>1</sup>*Kharkiv National University of Radio Electronics  
14 Lenin Ave., Kharkiv, 61166, Ukraine*

<sup>2</sup>*O. Ya. Usikov Institute for Radiophysics and Electronics of NAS of Ukraine  
12 Ak. Proskury Str., Kharkiv, 61085, Ukraine  
e-mail: nstognii@gmail.com*

Surface plasmons have been the subject of significant interest in recent years as they exhibit properties ideal for a wide range of potential applications. These include: plasmonic waveguides [1], subwavelength resonators [2], optical nanoantennas [3] and biosensors [4].

In this paper we consider the plasmon resonances of single metal nanowire and coupled

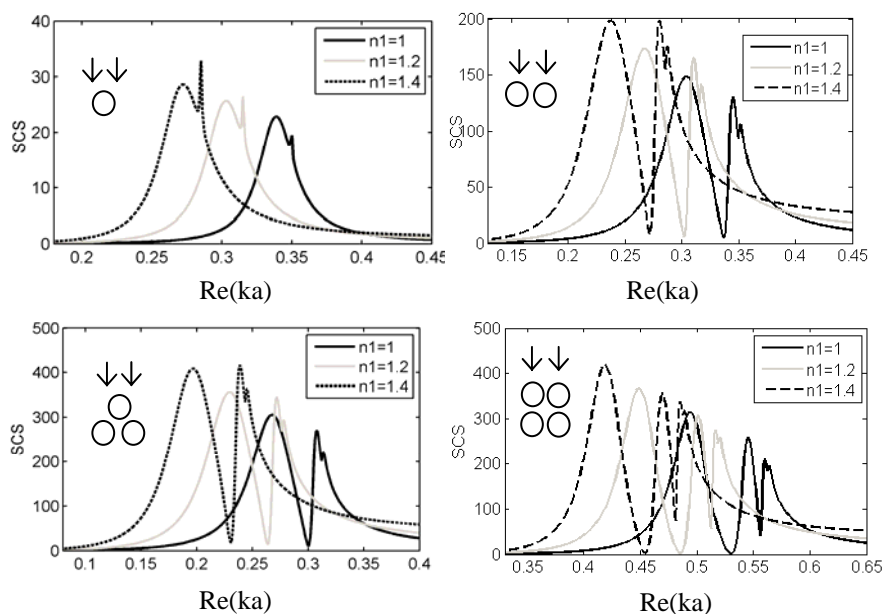


Fig. 1. SCS of single and coupled metal nanowires for different values of environment refractive index ( $\gamma = w_p \cdot 10^{-3}$ ,  $w_p = \omega_p a c^{-1} = 0.5$ )

with triangular or square configuration (see insets in Fig. 1). For modeling the normalized value  $w_p = \omega_p a c^{-1} = 0.5$  is used,  $c$  is the light velocity in vacuum. Illumination direction is shown in Fig. 1. It is seen that growing of the dielectric constant leads to the blue shift of plasmon resonances. Enhancement in sensitivity to environment properties is observable in the cluster with square configuration.

nanowires embedded in dielectric media with different values of permittivity. Radius of each wire is  $a$ , separation distance between them is  $d$ , frequency dependent dielectric permittivity  $\epsilon_p$  is given by the

Drude model  

$$\epsilon_p = 1 - \omega_p^2 (\omega(\omega + i\gamma))^{-1}$$

Here  $\omega_p$  represents the plasma frequency,  $\gamma$  is the material absorption. The following values of outer space refractive index have been considered:  $n_1 = 1$ ,  $n_1 = 1.2$ ,  $n_1 = 1.4$  ( $n_1 = \sqrt{\epsilon}$ ).

Figure 1 represents the scattering cross section (SCS) of single nanowire, pair of coupled nanowires and cluster

[1] Zhao Y. and Hao Y., "Finite-difference time-domain study of guided modes in nano-plasmonic waveguides", *IEEE Trans. Antennas Propag.*, vol. 55, pp. 3070–3077, 2007.  
 [2] Li J. and Engheta N., "Ultracompact sub-wavelength plasmonic cavity resonator on a nanowire", *Phys. Rev. B*, vol. 74, 115125, 2006.  
 [3] Bonod N., Devilez A., Rolly B., Bidault S., and Stout B., "Ultracompact and unidirectional metallic antennas", *Phys. Rev. B*, vol. 82, 115429, 2010.  
 [4] Byun K.M., Yoon S.J., Kim D., and Kim S.J., "Experimental study of sensitivity enhancement in surface plasmon resonance biosensors by use of periodic metallic nanowires", *Optics Letters*, vol. 32, no. 13, pp. 1902 – 1904, 2007.