Sample addressing in surface plasmon resonance experiments in the Kretschmann configuration revisited

I. Alonso[1]
J. Martínez-Perdiguero[2]

[1] *Dept. of Applied Physics II, Faculty of Science and Technology, University of the Basque Country UPV/EHU, Barrio Sarriena s/n, 48940 Leioa, Spain*
[2] *Dept. of Condensed Materr Physics, Faculty of Science and Technology, University of the Basque Country UPV/EHU, Barrio Sarriena s/n, 48940 Leioa, Spain*

ibon.alonso@ehu.eus

We analyze in detail the path of light rays in experiments which use prism-coupling for the generation of surface plasmon polaritons for sensing applications, in particular for the Kretschmann configuration. Due to the refraction of light at the surfaces of the prism, it is impossible to keep the interrogation spot at the same position as the prism is rotated, regardless of what rotation axis is chosen (Figure 1). Although this issue has been partially addressed by a few authors [1-5], in our opinion, the offered solutions are not completely satisfactory and they leave room for improvement. The effect can be of high importance and critical in cases where the sample analyzed is not homogeneous, such as arrays for multiplexing or thin films with defects. We calculate the walk-off of the incident ray over the sensing surface as a function of the angle of incidence at the side face of the prism for any rotation axis, and propose an optimized configuration so that the walk-off is minimized. Finally, we show experimental measurements to verify our calculations. Interestingly, these results may also be applied to other techniques which employ reflection prisms.

References

[1] R. Ulrich, R. Torge, Applied Optics 12(12), 2901 (1973).
[2] N. Horn, M. Kreiter, Plasmonics 5(4), 331 (2010).
[3] P. Qi, Y. Li, J. Zhong, Applied Optics 51(9), 1245 (2012).
[4] E. Fontana, G.O. Cavalcanti, Applied Optics 52(32), 7669 (2013).
[5] A.K. Singh, S.C. Sharma, Optics & Laser Technology 56, 256 (2014).

Figures

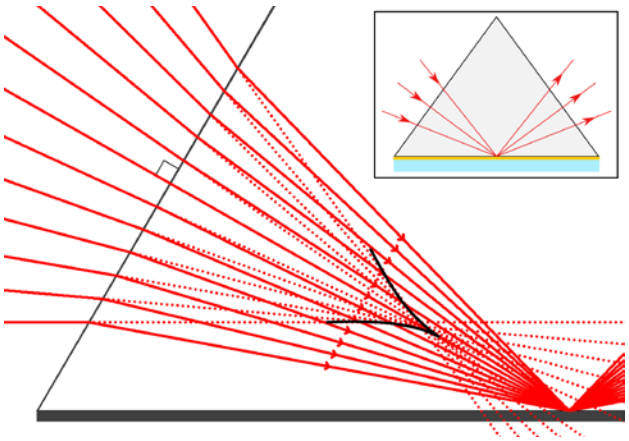

Figure 1: Paths of the rays arriving at the base of a prism at the same position after refraction on the side face. The extensions of the incoming rays (dotted lines) do not converge at a point, but produce a caustic (dark curve). So, conversely, with a fixed rotation axis for the incident beam arm or, equivalently, for the prism stage, maintaining a completely stationary interrogation spot on the sensing surface is not possible. However, an oversimplified and inaccurate scheme, which suggests the opposite, is quite commonly employed in the literature on SPR to illustrate the path of light as the prism is rotated (inset).