Reply to "Comment on 'Enhanced transmission of light through a gold film due to excitation of standing surface-plasmon Bloch waves' "

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We reaffirm our belief that there could be no purely local mechanism involving evanescent waves of any kind, which would explain the observed difference in light transmission through two plasmon resonators having exactly the same local geometry but different lengths.

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The preceding Comment by Weiner[1] misrepresents the main point of our original paper.[2] Before we proceed, let us discuss the issues of terminology. If a given feature on the metal film surface is illuminated by an external light source, the electromagnetic field around the feature may be separated into the evanescent (near field) and propagating (far field) components. The far field component may in turn be separated into three-dimensional (3D) (photons) and two-dimensional (2D) [surface plasmon polaritons (SPPs[3])] fields propagating away from the illuminated feature. It is clear from the preceding Comment that Weiner wishes to call the evanescent component of the field (or some portion of it) by a different name: a composite diffractive evanescent wave (CDEW). Such a name substitution is a matter of personal taste, which we do not wish to argue.

The real scientific issue addressed by our experiments reported in Ref. 2 is the mechanism (mechanisms) of the enhanced light transmission through a periodically nanostructured metal film.[4] Our motivation was to check if the enhanced transmission can be explained by a purely local mechanism involving evanescent waves only (as was assumed by the CDEW model reported in Ref. 5), or if some nonlocal mechanism is involved. Our experimental data presented in Figs. 2 and 3 from Ref. 2 clearly indicate that transmission of light through two plasmonic Fabry-Perot resonators differs by a factor of 4. These resonators have identical local geometry on the scale of a few micrometers. Hence from the point of view of evanescent waves of any nature (CDEW or any other kind) they are identical. The resonators are supposed to exhibit the same transmission in the CDEW model. Evanescent waves cannot see that these resonators have different total length.

In reality, quite the opposite behavior is observed. We see a very strong dependence of light transmission on the length of the resonators. Thus we firmly believe that our experiments establish nonlocal nature of the enhanced transmission of light through nanostructured metal films. In addition, we presented strong evidence in support of SPP involvement in this nonlocal behavior.

Let us now discuss some secondary points of the Comment. Weiner believes that a periodic arrangement of surface defects does not produce more efficient SPP excitation. This belief contradicts well-established experimental facts (see, for example Ref. 6). Phase-matching conditions do enhance energy exchange between external laser illumination and SPPs. On the other hand, Weiner is most certainly correct when he asserts that a single defect may excite a SPP wave under external illumination due to diffraction. However, this excitation is much less efficient. Moreover, this assertion is not new. Such SPP excitation by individual defects was demonstrated long ago in Ref. 7.

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