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Surface plasmon polaritons on curved surfaces: supplementary material

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This document provides supplementary information to "Surface plasmon polaritons on curved surfaces," https://doi.org/10.1364/OPTICA.6.000115, including a book-cover structure microscopic image and a derivation of Eq. (4) of the main text.

In the paper, we showed measurements of a 150 microns book-cover structure. In Figure 1(c) in the main text, we presented a measurement over the central 50 microns out of the 150 microns of the book-cover waveguide. The coupling grating is located ~30 microns from the edge of the structure to prevent reflections, as can be seen in the Figure S1.

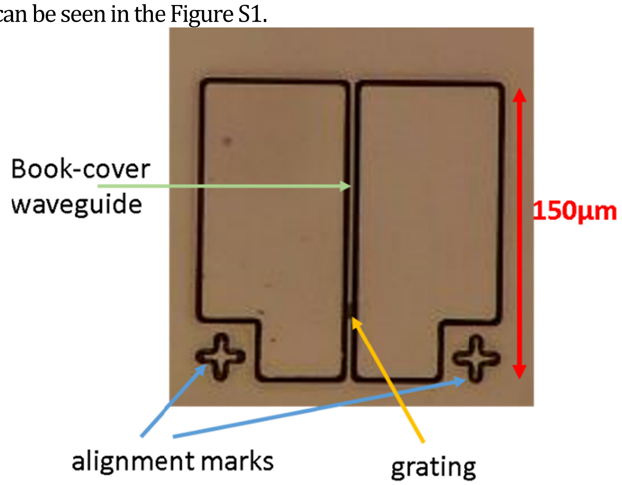

Fig. S1. Microscopic image of the measured book-cover structure

For the derivation of equation 4, we start with the Helmholtz equation:

$$\frac{\partial^2 E}{\partial x^2}+\frac{\partial^2 E}{\partial y^2}+\frac{\partial^2 E}{\partial z^2}+k_0^2 n^2 E=0, \quad \text{(S1)}$$

By applying the conformal transformation z+iy=R2*exp(v+iu/R2), the equation takes the form

$$\frac{\partial^2 E}{\partial u^2}+\frac{\partial^2 E}{\partial v^2}+exp\left(\frac{2v}{R_2}\right)\times\left(\frac{\partial^2 E}{\partial x^2}+k_0^2 n^2 E\right)=0, \quad \text{(S2)}$$

Since $R \gg v$, the Taylor expansion $exp(2v/R_2) \approx 1+2v/R_2$ can be applied. At leading order, there is an additional term to the Helmholtz equation $2v/R_2 \cdot k_0^2\, n_{eff}^2$. Therefore, the reduced Helmholtz equation on the surface (σ, z) is

$$\frac{\partial^2 \psi}{\partial \sigma^2}+\frac{\partial^2 \psi}{\partial v^2}+k_0^2 n^2 \psi+\frac{2v}{R_2} k_0^2 n^2 \psi=0, \quad \text{(S3)}$$

By applying the slowly varying envelope approximation on equation (3) the paraxial wave equation is

$$i\hbar\frac{\partial A}{\partial v}=-\frac{\hbar^2}{2n_{eff}}\frac{\partial^2 A}{\partial \sigma^2}-\frac{\hbar^2 A}{8n_{eff}S^2(\sigma)}-\frac{n_{eff}}{R_2}v(q_2)A, \quad \text{(S4)}$$