Supplementary Information (Updated July 09-2009)

Temperature model

We have used the thermal model described in detail in Ref. 19 of the manuscript for the heating of thin metal films on SiO_2 substrates. Here we summarize the relevant information.

The 1D laser heating equation of the thermal model is:

$$\frac{dT}{dt} = [1-R(h)]\frac{E_0}{\sqrt{2\pi}\sigma}\frac{[1-exp(-\alpha_m h)]}{(\rho C)_m h}f(t) - \frac{q_s(t)}{(\rho C)_m h}$$

Where the Gaussian laser pulse shape is $f(t) = exp(\frac{-(t-\mu)^2}{2\sigma^2})$, E_o is the laser energy density and q_s is the conductive heat transfer to the substrate. The solution of this heat equation is the description of temperature T as a function of time t and thickness h of the film for the Gaussian shaped laser pulse. The solution is given in terms of a Laplace transform as:

$$T(t,h) = T_0 + S^{'}(h)\int_0^t exp(-f^2(t-u))^2 + g(t-u) + K(h)^2 u)\cdot erfc(K(h)\sqrt{u})du$$

where u is the Laplace transformation variable and the other quantities are:

- $f = \frac{1}{\sqrt{2}\sigma}$, where $\sigma = \frac{t_p}{2\cdot\sqrt{2\cdot ln(2)}}$ is the standard deviation of the Gaussian laser pulse of pulse width $t_p = 9\times 10^{-9}$ s
- $g = 2t_p f^2$
- $S^{'}(h) = [1-R(h)]\frac{E_0}{\sqrt{2\pi}\sigma}\frac{[1-exp(-\alpha_m h)]}{(\rho C)_m h}exp(-f^2 t_p^2)$ where α_m is metal the absorption coefficient at the laser wavelength of 266 nm , ρ is the density, C is the heat capacity and m designates the metal
- R(h) is the thickness-dependent reflectivity of the metal-substrate bilayer and is given by:
  - $R(h)_{Co} = \frac{0.426\mathrm{e}^{9.543\cdot 10^7 h} + 0.321\mathrm{e}^{-9.543\cdot 10^7 h} - 0.699\cos\left(6.803\cdot 10^7 h\right) + 0.242\sin\left(6.803\cdot 10^7 h\right)}{\mathrm{e}^{9.543\cdot 10^7 h} + 0.137e^{-9.5429\cdot 10^7 h} + 0.06832\cos(6.803\cdot 10^7 h) + 0.736\sin(6.803\cdot 10^7 h)}$
  - $R(h)_{Ag} = \frac{0.261\mathrm{e}^{6.345\cdot 10^7 h} + 0.180\mathrm{e}^{-6.345\cdot 10^7 h} - 0.391\cos\left(6.54\cdot 10^7 h\right) + 0.185\sin\left(6.54\cdot 10^7 h\right)}{e^{6.345\cdot 10^7 h} + 0.0468\mathrm{e}^{-6.345\cdot 10^7 h} + 0.180\cos(6.54\cdot 10^7 h) + 0.393\sin(6.54\cdot 10^7 h)}$
- and $K(h) = \frac{\sqrt{(\rho C_{eff} k)_s}}{(\rho C_{eff})_m h}$, where k is the substrate thermal conductivity and s designates substrate parameters and C_{eff} is the effective value of the film heat capacity during heating, cooling, and changing phase.

The various quantities used in the calculation are noted in table 1

Material	C in J/Kg-K	ρ Kg/m^3	$\alpha(266\,nm)$ in m^{-1}	k in W/m-K
Ag	283	$9.33\cdot 10^3$	$6.344\cdot 10^7$	
Co	686	$7.67\cdot 10^3$	$9.543\cdot 10^7$	
SiO_2 substrate	937	$2.20\cdot 10^3$	≈ 0	1.4

Table 1: Metal and substrate quantities