**Supplementary materials**

Description of the stacking

The simplest design of solar receiver would be a set of coated tube. These metallic tubes would be coated with one or several ceramic layers. You can find below how the original stacking was planned.

Strain accommodation layers

Diffusion barrier layers

Metallic substrate

Adsorbing, conductive and anti-oxidation coating (10-100 µm)

**Selection of conductive materials to accommodate strain and diffusion: in situ etching (H2) and nitriding (NH3) of the metallic alloy will be first used**

**Selection of a metallic alloy with high stability at HT: molybdenum alloys will be first studied**

Adsorbing and anti-oxidation coating

**Selection of a conductive, adsorbing and oxidation-resistant material: AlN is the first candidate**

Figure S1. Schematic representation of a multilayer multifunctional coating.

Description of Raman and PL measurements

The measurements of biaxial residual stress in AlN and Al2O3 layers were carried out with a T64000 spectrometer (Horiba Jobin-Yvon). The excitation source was an Ar+-laser with 514 nm wavelength. Its power was adjusted to prevent shift of frequency resulting from heating of samples. For AlN, its E2(high) phonon frequency shifts linearly with biaxial stress from its stress-free value [1, 2]. Hence, the biaxial stress in AlN was directly obtained from Raman shift [2]. For Al2O3, its residual stress was determined by measuring piezospectroscopic shift of Cr3+ luminescence [3, 4]. Cr3+ ions are impurities incorporated (from APMT substrate) into the growing Al2O3 layer. The relationship between biaxial residual stress in Al2O3 layer (σ) and piezospectroscopic shift of Cr3+ (∆ν) was given by [4]:

$$∆ν=\frac{2}{3}Π\_{ii}σ$$

with a piezospectroscopic coefficient Πii of 7.60 cm-1·GPa-1.

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Figure S2. Residual stresses in AlN coating and Al2O3 growing layer as a function of oxidation time; T=1373 K