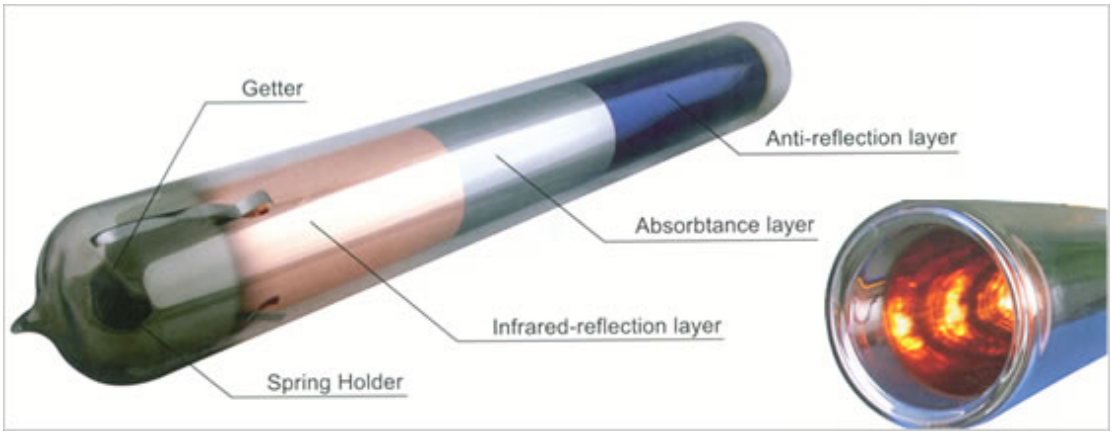
Sunrain's **MC** evacuated tubes **three-**target plates sputtering selective-coating surface (also called " Double M-ALN cerment layers),developed on the based of TYY-AA evacuated tubes, which achieve the highest thermal efficiency and good thermal stability. Solar selective coatings absorb most solar radiation while simultaneously suppressing the thermal emittance loss from coating surfaces has higher absorption (> 95 %) and lower emittance (< 5 %) than traditional selective coating surface. The sputtering selective-coating absorber is high resistance to long-term vapor condensation, high corrosive sulfur dioxide and high operating temperature. The effective resistance measured in the test is equivalent to a product life span exceeding 15 years. Good absorber material should have excellent heat transition, good resistance to corrosion and good welding ability.

The sputtering is a physical manufacturing process that involves coating a substratum with metal particles. The manufacturing process takes place in a high vacuum chamber and the coating process involves three stages, stabilizing layer coating, semi-conductor layer coating (radiation absorbent layer) and anti-refection layer coating, as shown in the following diagram.



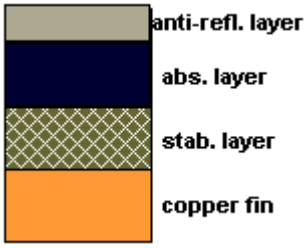
First deposition is a copper metal layer, which has low emission ratio and high thermal transmission through inner glass wall to the refrigerant heat pipe.

Second deposition is ionized stainless steel sputtered simultaneously in gas mixture of argon and nitrogen to produce cermet.

Third deposition is aluminum nitride which absorbs solar radiation at very low emissivity, a = 95% ; e = 5%.

In the vacuum chamber **three** target plates are installed above the copper fin. By creating a high-tension field between the targets and the copper fin and a magnetic field parallel to the target plates, positive helium ion release titanium atoms from the target plate. The atoms strike

the copper fin and because of high kinetic energy of the atoms they attach themselves to the top of the copper fin. During the process this copper fin passes three targets plates.



A stabilizing layer of metal is laid on the copper fin. This layer gives the surface of the copper fin long-term stability.

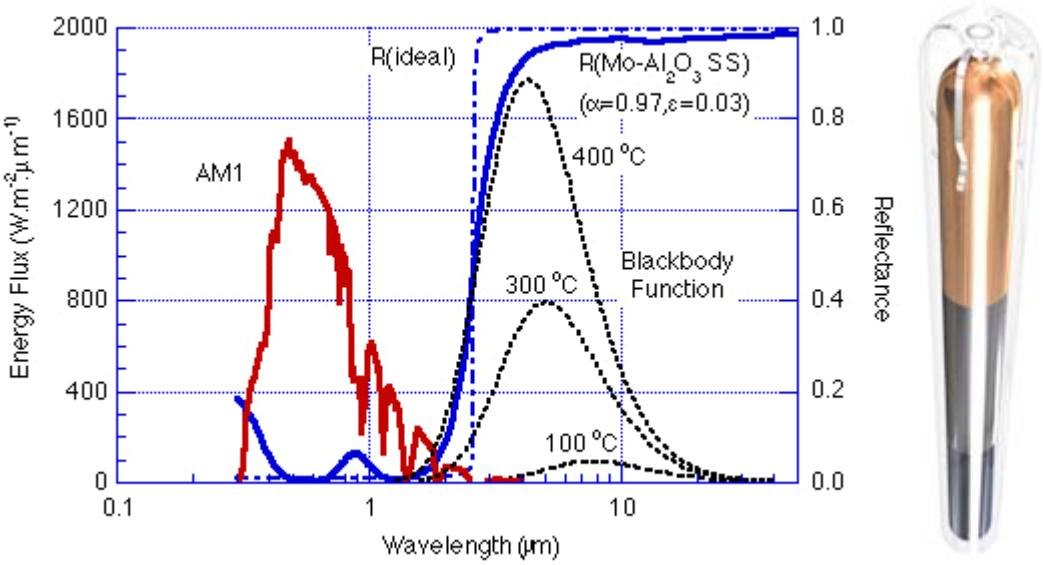
In this semi-conductor layer Cu atoms are orientated in such a way that 98% of incoming solar radiation can be absorbed. Finally, a tramsparent ALN or ALNxoy anti-reflection layer is added on the absorbent layer to enhance solar absorption. The anti-reflection layer has a very low reflection index and can let 98 to 99 % of incident solar radiation pass through the layer to be absorbed by the semi-conductor layer.Thus, A solar absorptance of 0.94 - 0.96 with an emittance of 0.04 - 0.06 at 100 ℃ has been achieved

Advanced solar selective coatings employ two patent technologies :

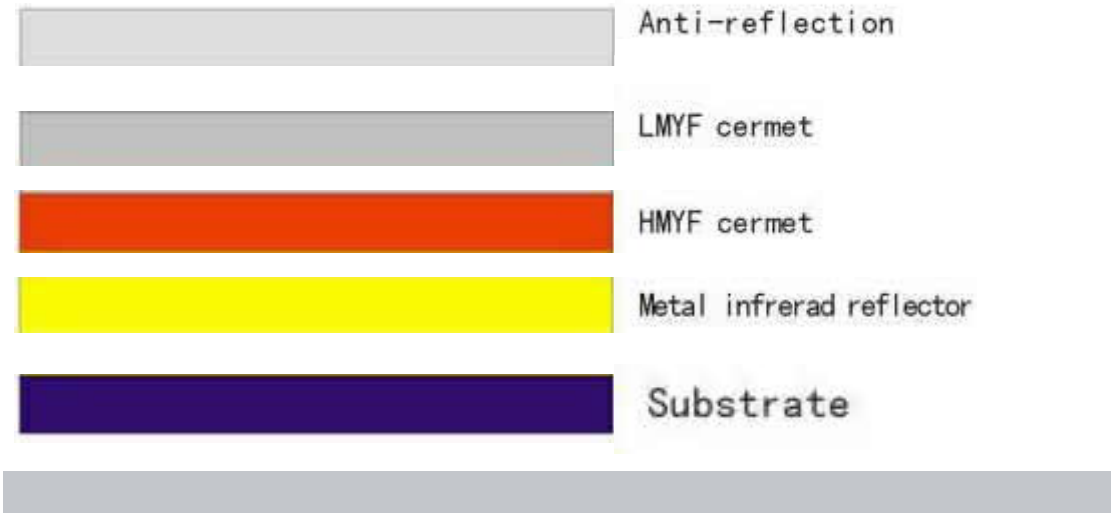
(1) double cermet film structure with the highest photothermal efficiency

(2) metal-Aluminum nitride cermet (M-AlN) materials deposited by a novel sputtering technology.

The typical film structure of M-AlN cermet selective surfaces :



schematically shown in the figure one



- The layer of reflection reducing layer will reduce the reflect ratio, and improve efficiency of heat collection, increase the absorbing performance to sun rays. Reflect ratio will be reduced by 30%-40%
- The mirror surface red copper and stainless steel absorbing film are used on double reflecting layers to reduce heat emittance and heat loss, and improve the performance of heat preservation

Absorbing layer has the special intervention film of stainless steel aluminum nitride metallic ceramic. Working normally under temperature as high as 300 ℃ . Aging resistance: no color fading for 15 years. High heat collection: absorbing ratio is improved by 15%.

It is well known that the two seals of evacuated tubes are carried out up to @ 800 C temperature when we produce the seals of common evacuated tubes,its film can not stand up so high temperature degree and the film often changes into another colour or falls down ,so there is far distance from the seal,which is about 40-45mm . (Our TYY-AA tubes is 25-30mm)

Our TYY-MC evacuated tubes make use of advanced Stainless steel ALN "THREE-TARGET" sputtering technique (while TYY-AA is one-target sputtering),so that they can stand up so high temperature.Especially the film leaves near from the seals ,which is 20-25mm .
Besides , such solar collector evacuated tubes can abserve the solar Infrared ,so the collecting heat is more effective than common evacuated tubes .