Nontrivial Atomic-scale Heterostructures

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1 Introduction

Sr_2RhO_4 is a chemical compound that is typically created from $SrCO_3$ and $1Rh_2O_3$.Iit is a novel correlated electron metal [4]. Sr_2RhO_4 is possibly a superconducting material which is why more research is needed on it [3].

Sr_2RhO_4 is an interesting compound because according to Perry, it can be used as a " 'benchmark' high purity correlated electron metal" [4]. To first explore the crystalline structure of Sr_2RhO_4 it is necessary to produce some amount of the compound. We are able to produce Sr_2RhO_4 by finding it's balanced chemical reaction:

$$4SrCO_3 + 1Rh_2O_3 => 2Sr_2RhO_4 + 4C + 30_2 + 1O.$$

These two reactants create the product Sr_2RhO_4 in a solid state reaction. In order to produce one gram of Sr_2RhO_4 we need .863 grams of $SrCO_3$ an .3709 grams of Rh_2O_4. This will also create by-products of Carbon and Oxygen which may or may not form carbon dioxide.

After producing a big enough sample of Sr_2RhO_4 which will be in a powder form we can place our thin film into an X-ray diffractometer. The X-ray diffractometer is a device which will bombard our substance with X-rays and will record exactly how the X-rays bounce or pass through our substance. Then by using advanced mathematics the X-diffractometer can create an accurate 3-D representation of what the actual substance looks like down to the atomic scale [2]. This will show us how the crystalline structure between the atoms of Sr_2RhO_4 function. We press the powder of the substance into a pellet with a dry pressing machine then we fire it in a furnace to help remove impurities. We can create the thin film using pulsed laser deposition, a technique for creating very thin strips of a material with a laser beam [1]. Pulsed laser deposition works by shooting a laser at target material which is our pellet of Sr_2RhO_4. This will excite the target material creating a plasma plume of that material which will deposit on an appropriately placed substrate. The substrate is typically heated which helps for the growth of the thin film. Different controllable parameters such as the air content and pressure, substrate material, substrate temperature, energy of the laser, and repetition of the laser will all affect the quality and behaviors of the final film [1]. See figure 1 for a schematic overview of how PLD works.

With the thin film of the substance we will be able to use atomic force microscopy in 'tapping' mode which is where the needle which moves over the surface of the film

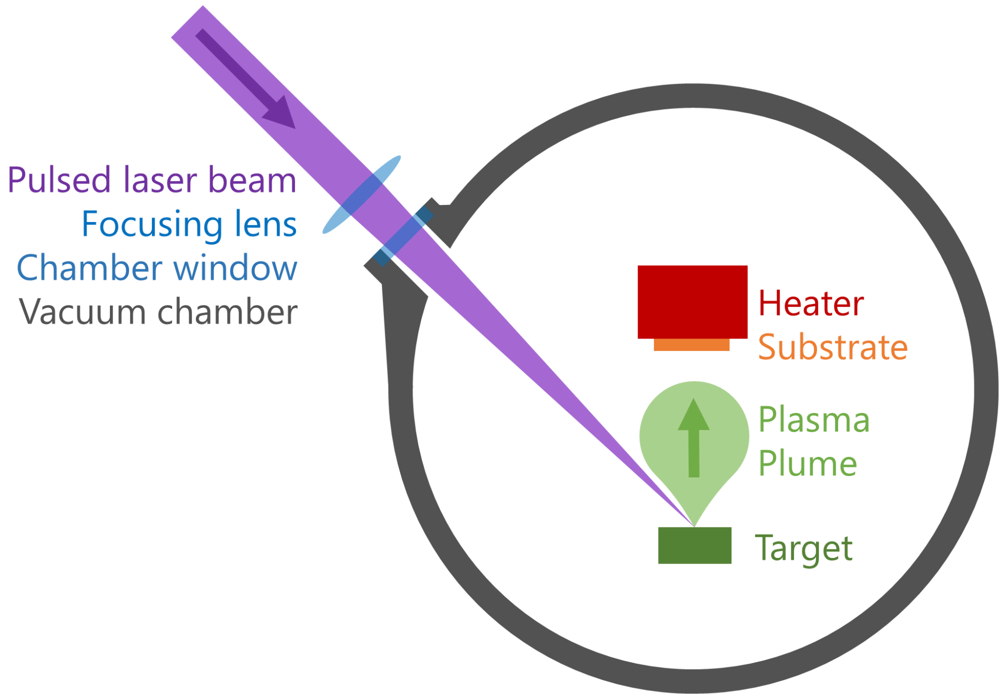

Figure 1: Diagram of PLD Setup [5]

to map its topography doesn't make full contact with the film continuously. Instead the needle will move up and down and strike the surface which is interpreted as a signal giving the height of the surface of the substance against the distance axis. This tapping mode reduces wear on the equipment and film and also generates a more accurate topography scan.

Finally, Using these research techniques we will be able to complete and in-depth analysis on Sr_2RhO_4.

References

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