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*Research Paper*

# INVESTIGATION FOR EFFECT OF MECHANICAL PROPERTIES OF CHROMIUM CARBIDE COATED ON COPPER ROD

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The mechanical properties like tensile, hardness of copper rod coated with chromium carbide of the test specimens for performance critical applications are presented and discussed. The tensile strength and hardness and microstructure of the copper rod and copper rod coated with chromium carbide of the test specimens, quantified in terms of reduction-in-cross-sectional area, was higher for the transverse specimen. The elongation-to-failure of the test specimens was identified. The tensile fracture behavior of the copper rod and copper rod coated with chromium carbide was quantified by careful examination of the microstructure surfaces in a scanning electron Microscope. The intrinsic fracture features on the tensile fracture surface were discussed. Taking into consideration the nature of loading and contribution from intrinsic microstructure features.

***Keywords:*** Tensile, Hardness, Microstructure, Copper rod, Chromium carbide coated

## INTRODUCTION

### Coating

A coating is a covering that is applied to the surface of an object, usually referred to as the substrate. The purpose of applying the coating may be decorative, functional, or both. The coating itself may be an all-over coating, completely covering the substrate, or it may only cover parts of the substrate.

### Introduction to Copper

The major uses of pure, unalloyed copper are based on its high electrical and thermal conductivity as well its good corrosion resistance. Almost all alloying elements are detrimental to the electrical conductivity of copper, making the purity of the metal an important issue. Commercially pure copper is represented by UNS numbers C10100 to C13000. The of the powder. The next step is a ores are crushed and milled until they become a powder. A technique known as flotation separates the metal from the non-metal components concentrating stage where

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minerals are concentrated into slurry that is about 15% copper. The copper is then melted and purified in several stages until it is 99% pure copper.

### Introduction to Chromium Carbide

Chromium carbide is a ceramic compound that exists in several different chemical compositions: $Cr_3C_2$, $Cr_7C_3$, and $Cr_{23}C_6$. At standard conditions it exists as a gray solid.

$$3Cr_2O_3 + 6Al + 4C \rightarrow 2Cr_3C_2 + 3Al_2O_3$$

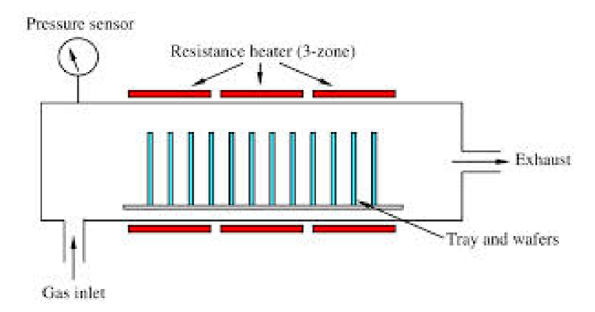
### Benefits & Uses

Coatings of chromium carbide are recommended for resistance to wear by abrasion, fretting, cavitation, and particle erosion in high temperature applications. Chromium carbide surfacing resists oxide pick-up in high temperature atmospheres for steel production. This reduces product damage on components that directly contact steel strip and other shapes during high temperature annealing. Turbine components with critical initial testing and proven results under extended and demanding operations make the wear resistance of chrome carbide coatings an ideal solution. Chromium carbide also provides significant benefits in applications where the part would be exposed to environments that move solid particles in erosive gasses by coating the duct work and fan surfaces.

## COATING PROCESSES

CVD is a chemical process used to produce high-purity, high-performance solid materials. The process is often used in the semi-conductor industry to produce thin films. In typical CVD, the wafer (substrate) is exposed to one or more volatile precursors, which react and/or decompose on the substrate surface to produce the desired deposit. Frequently, volatile by-products are also produced, which are removed by gas flow through the reaction chamber. Processes widely use CVD to deposit materials in various forms, including: monocrystalline, polycrystalline, amorphous, and epitaxial. These materials include: silicon, carbon fiber, carbon nanofibers, filaments, carbon nanotubes, $SiO_2$, silicon-germanium, tungsten, silicon carbide, silicon nitride, silicon oxynitride, titanium nitride, and various high-k dielectrics. CVD is also used to produce synthetic diamonds.

**Figure 1: Chemical Vapor Deposition**

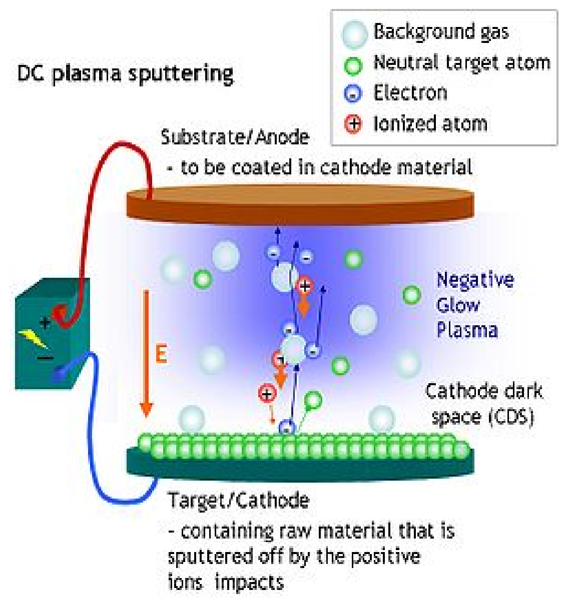



## Physical Vapor Deposition

Physical vapor deposition (PVD) describes a variety of vacuum deposition methods used to deposit thin films by the condensation of a vaporized form of the desired film material onto various work piece surfaces (e.g., onto semiconductor wafers).

The coating method involves purely physical processes such as high-temperature vacuum evaporation with subsequent condensation, or plasma sputter bombardment rather than involving a chemical reaction at the surface to be coated as in chemical vapor deposition.

**Figure 2: Physical Vapor Deposition**




# RESULTS

Results Comparison Between Carbon rod and Carbide coated carbon rod.

## In Tensile Test by Using UTM

**Table 1: Strength of Two Copper and Copper Chromium Carbide Coating Material**

| S.No. | Material | Coating | Tensile strength (MPa) |
|---|---|---|---|
| 1 | Copper | ------ | 219.88 |
| 2 | Copper | chromium carbide | 219.92 |

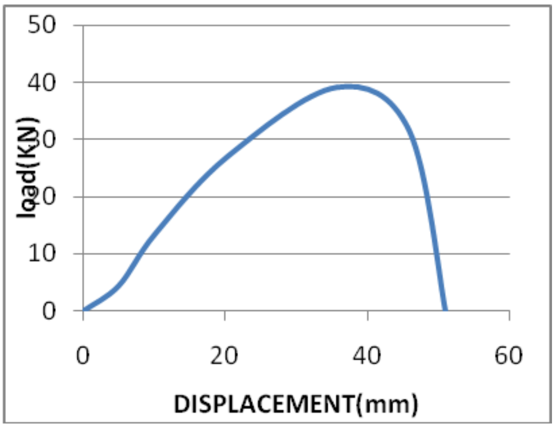
## Hardness test results

**Table 2: Hardness Test Result for Copper and Copper Coated Chromium Carbide**

| S.No. | Material | Coating | Hardne ss Value |
|---|---|---|---|
| 1 | Copper | ------ | 30 |
| 2 | Copper | chromium carbide | 37.5 |

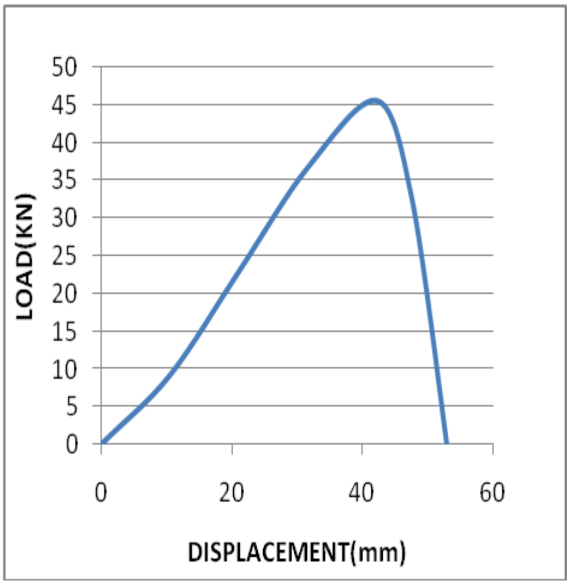
# LOAD VS DISPLACEMENT GRAPH OF COPPER ROD

**Figure 3: Copper Rod Load Vs Displacement Graph of Copper Rod**



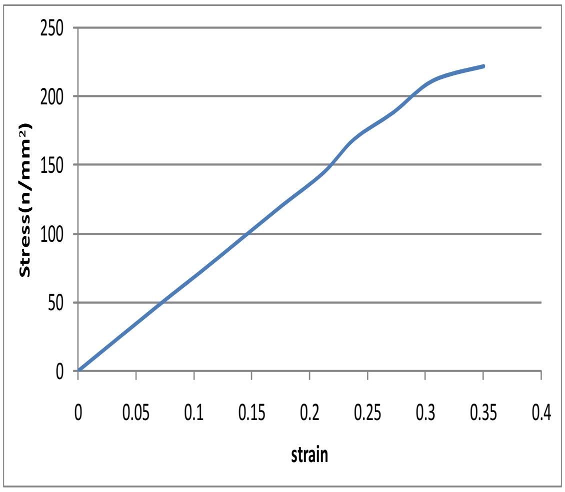

# LOAD VS DISPLACEMENT OF COPPER COTTED WITH CHROMIUM CARBIDE

**Figure 4: Copper Rod Coated With Chromium Carbide**



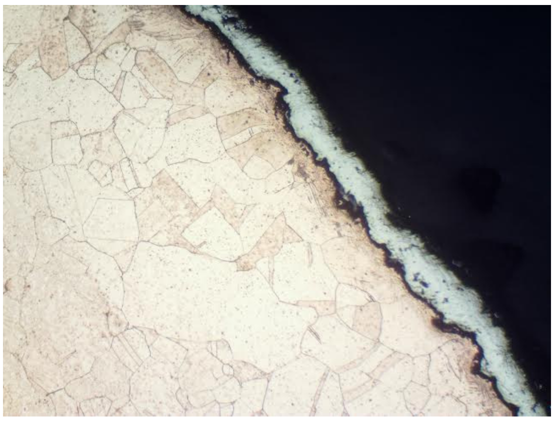

# STRESS STRAIN OF COPPER ROD COATED WITH CROMIUM CARBIDE

**Figure 5: Stress And Strain Copper Rod Coated With Cromium Carbide**




## MICROSTRUCTURE OF COPPER ROD COATED WITH CROMIUM CARBIDE

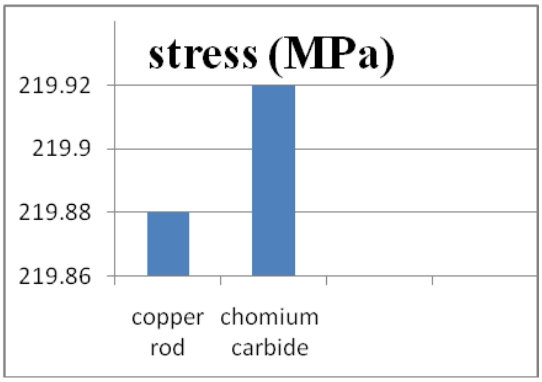
**Figure 6: Microstructure of Copper Coated With Chromium Carbide**



### Tensile Test Result

Tensile test comparison and the hardness test comparison from the values of copper rod and copper rod coated with chromium carbide is improved to 0.04 MPa in tensile test and 7.5 HRB in hardness test.

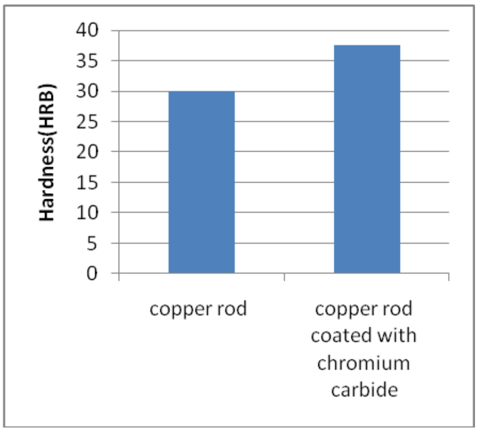
**Figure 7: Stress Comparison Between Copper Rod and Chromium Carbide Coated Copper Rod**




### Hardness Test

Copper rod coated with chromium carbide improved from 219.88 MPa to 219.92 MPa as 0.04MPa in tensile strength hardness value increased from 30 HRB to 37.5 HRB.

**Figure 8: Hardness Comparison Between Copper Rod and Chromium Carbide Coated Copper Rod**




## CONCLUSION

tensile test comparison from table:1 and the hardness test comparison from table:2 the values of copper rod and copper rod coated with chromium carbide is improved to 0.04 MPa in tensile test and 7.5 HRB in hardness test

By observing the above figure 7, we concluded that copper rod coated with chromium carbide improved from 219.88 MPa to 219.92 MPa as 0.04MPa in tensile strength.

By observing the above figure 8, hardness value increased from 30 HRB to 37.5 HRB.

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