INTRODUCTION:
Cemented carbides are very hard materials. These are used in making cutting tools, rock drilling, mine blasting applications, and steel roll mills. High hardness results in a very low impact resistance. The cemented carbide articles tend to be very brittle and break easily when subjected to high impact loads.

OBJECTIVE:
This project aims to reinforce Graphene Nano Platelets into the WC-Co matrix. The main objective of reinforcing graphene is to enhance the impact resistance of WC-Co without much appreciable decrease in the hardness. In this way the tool life can be extended. This hence reduces the costs to the industry significantly.

METHODOLOGY:
In this project we shall make an attempt to reinforce Graphene Nano Platelets in WC-Co by two different routes.

Ball Milling-Ultrasoundation-Vacuum Sintering
The WC-Co (about 6% Co) powders would be ball-milled to get a uniform size distribution and to break down the lumps. This would be followed Ultrasonication with Graphene using N-Methyl Pyrolidone as the solvent. The slurry would be vacuum dried to obtain a Graphene mixed WC-Co powder. This powder would be pressed by Hydraulic Press and Vacuum Sintered at ~1400C in a furnace. The sintered compacts would be analysed for the Physical Properties (Coercive Force, Magnetic Intensity, Specific Gravity), Metallurgical Properties (Hardness, Toughness, Microstructure, Grain Size, and GNP Distribution)

High Energy Ball Milling-Spark Plasma Sintering
WS-Co and Graphene would be mixed using a High Energy Ball milling operation to get nanosized powders. These powders would be then subjected to Spark Plasma Sintering at varied temperature and pressure parameters to obtain a near 100% densification. The compacts formed would be analyzed for Physical and Metallurgical Properties.
CONCLUSION:
Increasing the impact resistance of WC-Co Composites without much appreciable decrease in their hardness. This can be ensured by the retention of Graphene in the matrix and preventing its conversion into graphite or amorphous carbon during sintering.

A positive outcome of this project can encourage graphene reinforcements in various hard materials to increase their fracture rupture strength. This could help industries to increase their tool lives by delaying the fracture.

FUTUREWORK:
The following works will be carried out in future:
1. The major part of the mixed powders will be subjected to Spark Plasma Sintering at varied temperature and pressure parameters to obtain a near 100% densification.
2. The compacts formed will be analyzed for Physical and Metallurgical Properties.