CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Shreya S. Ranganath

Project Number
34433

Project Title
A Sandwich Stops Bullets!

Abstract

Objectives/Goals
There is nothing more precious than life! Yet, in the United States and around the world, many lives are being lost because of senseless killings due to possession of high-powered rifles and bullets in the hands of bad guys. My Science and Engineering project on a "composite sandwich" shows how to blunt these attacks and protect what we truly value the most.

Methods/Materials
Various kinds of materials were tested - high-strength steel, aluminum, hard ceramic facing, and especially fabricated novel single- and double-layer composite sandwiches # against 9 mm, 10 mm (.40 caliber) and 5.56 mm high speed bullets. The depth of penetration on a back-up steel was measured in each test. An effort was then made to relate the Areal Density, i.e. the weight (kg) per unit area (m2) of material necessary to provide full protection, with the properties of the metals and composites. The analysis of results seem to prove the hypothesis: "That if ceramics such as Alumina (Al203), which are brittle and easily breakable under tension, could be bonded with a tougher backing material in composite construction, then the high hardness, elastic modulus and compressive strength of this ceramic could fracture or mushroom the head of the high speed bullets upon impact. If this were to happen, the backing material would then deflect to absorb the remaining kinetic energy (1/2 mv2) and stop the bullets and ceramic fragments."

Results
Fractographic observation of the bullets and the target further helped in designing and fabricating the best lightweight and most cost-effective bulletproof armor composite. It has been shown in this research that the double-layer ceramic facing composite with carbon-fiber backing will be more than 3 times lighter than Aluminum and Steel in providing same level of protection against all three types of bullets.

Conclusions/Discussion
I'm hopeful that the fruits of my research and development would find additional noble applications in blast-proof shelters and aircrafts, bullet proof safe-enclosures in schools, impact-resistant cars/choppers, neutron radiation shielding tanks, acoustic panels, and home insulations...for these, please stay tuned!

Summary Statement
A cost effective lightweight novel composite has been produced in this project which provides full protection against bullets, and could easily be tailored for potential applications in aerospace, automotive, defence and electronics.

Help Received
Used equipment at DA Graphite Inc to cure laminate; Retired Police Officers helped test the fabricated composite in my presence at the American Shooting Center, San Diego.