



Nanotechnology in Bullet-proof vests

Material Technology - Sir Kamran Nawaz



What exactly are bulletproof vests?

Bullet proof vests or ballistic vests are sometimes called bullet resistant vests simply because its incorrect to refer to them as "bulletproof" due to elevating and varying kinds of projectile.

This expression indicates that the vest can guard the user from every firearm threat, so the phrase bullet resistant is usually preferred. These vests are usually worn in the torso region. This form of body armor may serve as protection because it can absorb impact from undesirable items that are generated by firearms and bombs.

Types and Materials Utilized

There are different kinds of bulletproof vests:

To find out which type of bulletproof vest to use can depend on the type of damage the person is anticipating to come across. Soft vests, that are commonly being utilized by security guards, bodyguards, civilians and the law enforcement officials, are manufactured using a number of levels of woven or laminated fibers. This sort of vest has the ability to guard the consumer from less severe small-caliber weapons including handgun and shotgun bullets or smaller fragments from hand grenade explosions.

Moreover, extra material can be integrated into these vests for better security using metal or ceramic plates. Hard-plated reinforced vests are generally utilized by units with a more extreme and dangerous occupation description such as the military combat soldiers, police tactical and hostage rescue squads. The additional metal or ceramic plates are more efficient in protecting the wearer from more serious and aggressive damages. These includes rifle rounds and stabbing or slashing assaults from sharp objects.



How these protective gears work:

Although bullet proof vests may prevent bullet penetration, it could still cause damage to the wearer because of blunt force trauma. These vests function in such a way that the fibers merely deform the approaching bullet into a dish shape where its power is distributed on a large region of the fiber material.

The deformation allows the bullet to stop before it can completely penetrate and go through the material. Just a few layers of the fabric can be penetrated by the vest therefore soaking up the energy. Nevertheless, the individual may nonetheless absorb partial energy from the bullet and may cause enough impact that may lead to injury. That is why there are vest specifications that give the customer particulars, both on the penetration resistance requirements and also the limits on the quantity of impact energy that may be brought to the body.





Raw Materials:

- Commercially used synthetic fibers include Kevlar, Spectra, Twaron, Ballistic Nylon and Zylon.
- Mostly used material for bulletproof vest is Kevlar.
- Kevlar is not used in pure form because it has some drawbacks.
- Use of Spectra for vests is also increasing now a days.



Drawbacks of using Pure Kevlar fiber:

- It is degraded by the UV Rays.
- Low stability under wet conditions because Kevlar has low strength under wet conditions.
- Therefore, Kevlar is blended with a natural fiber which is mostly Wool.

Blended fabric of Wool and Kevlar:

- **Advantages:**

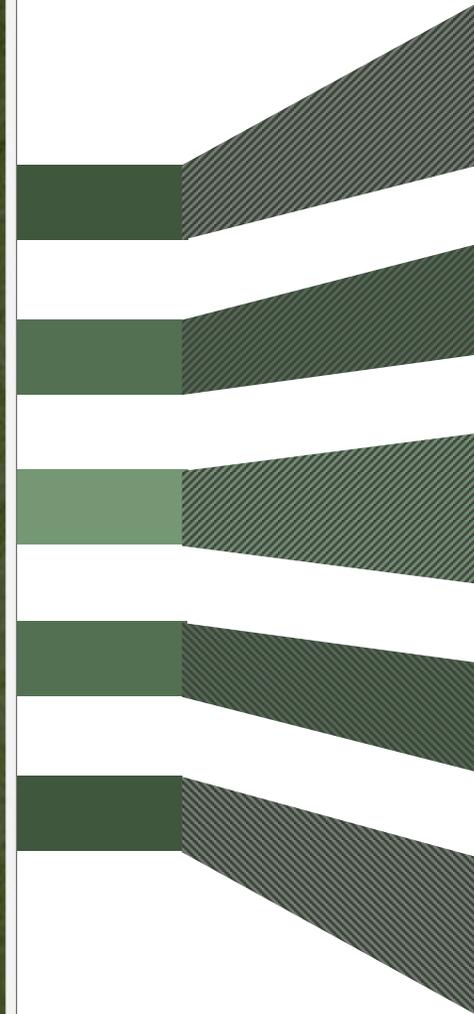
- Better tear strength even under wet conditions.
- Better energy absorbing capacity and reduced number of layers in a vest.
- Better breathability and feels good on skin.
- Restricts the displacement of Kevlar yarns under the impact of bullet.
- Increases the friction at yarn intersections and penetrating bullet comes across a stronger resisting force.

Manufacturing of Kevlar Filament:

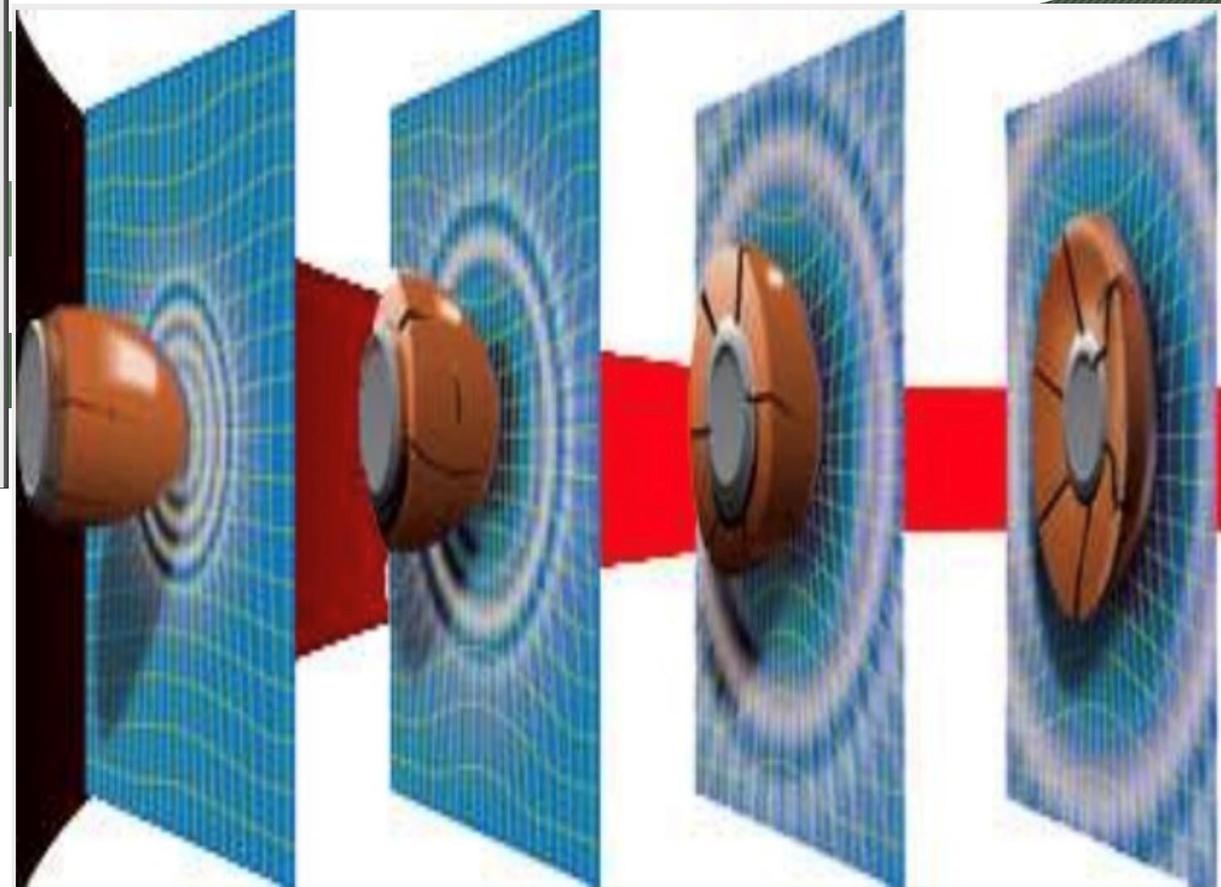
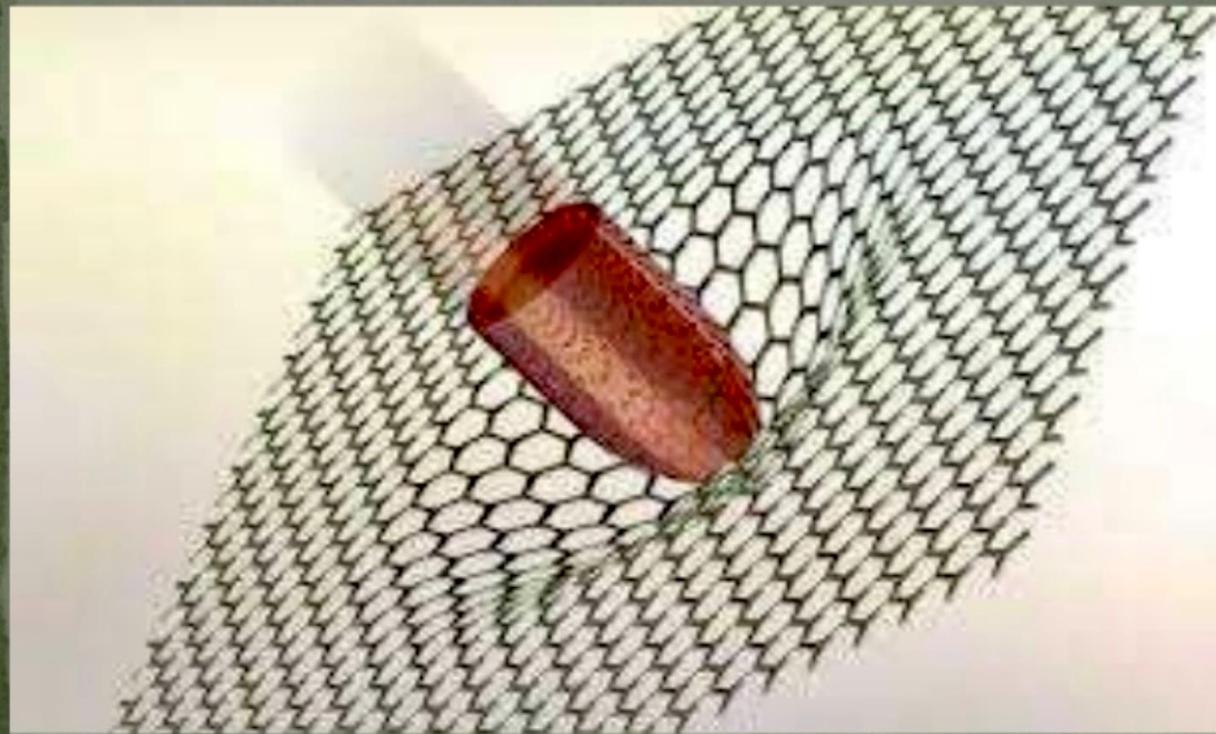
- To make Kevlar, the polymer poly-para-phenylene terephthalamide is first produced in the laboratory. This is done through a process known as polymerization, which involves combining molecules into long chains. The resultant crystalline liquid is then extruded through a spinneret to form Kevlar yarn. The Kevlar yarn then passes through a coagulation bath to help it harden.

Fabric Technique:

- The Kevlar yarn is then twisted to make it suitable for weaving. To make Kevlar cloth, the yarns are woven in the simplest pattern, plain weave, which is merely the over and under pattern of threads that interlace alternatively.



How bullet is Resisted?





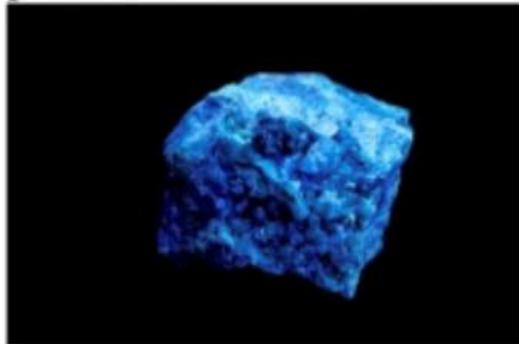
Impact of Nanotechnology on Defense

- With the highly promising expectations of nanotechnology for new innovative products, materials and power sources it is evident that nanotechnology can bring many innovations into the defence world. In order to assess how these nanotechnology developments can or will impact upon future military operations, the Defence R&D Organisation has requested to compile a nanotechnology road map for military applications.



NANO-ARMOR

- Another method for creating super strong materials uses tungsten, not carbon, for the basic material.
- It is five times stronger than steel and at least twice as strong as any impact-resistant material currently in use as protective gear. It has withstood the equivalent of dropping four diesel locomotives onto an area the size of a fingernail.
- Possible applications for this new nano material are ballistic protection personal body armor, bullet proof vests, vehicle armor, shields, helmets, and protective enclosures.





Nanotechnology for the soldier

- Nanotechnology enables high strength, durable, sensoric and active materials.
- ✓ **Lightweight protective clothes:** flexible antiballistic textiles, self BC decontaminating nanofiber fabric,
- ✓ **Adaptive suit:** switchable fabric for improved thermal control, microsensors for body & brain sensing, environmental and situational awareness, to be integrated into a smart suit or helmet, wearable and flexible displays for visual feedback ,
- ✓ **Auxiliary supports:** flexible/rigid textiles for additional, strength, exoskeletons and robotics to assist the human tasks.



Waterproof and Bullet-proof Vests

- One of the first advancements that came out of the center was developed by Prof. Karen Gleason.
- She and her researchers were able to create ultra hydrophobic surfaces (waterproof) using a technique called chemical vapor deposition (CVD).
- With CVD they could deposit nano layers of Teflon (yes, the same stuff that's on your frying pan) on Kevlar panels, the material used to make bullet-proof vests.







Thank You