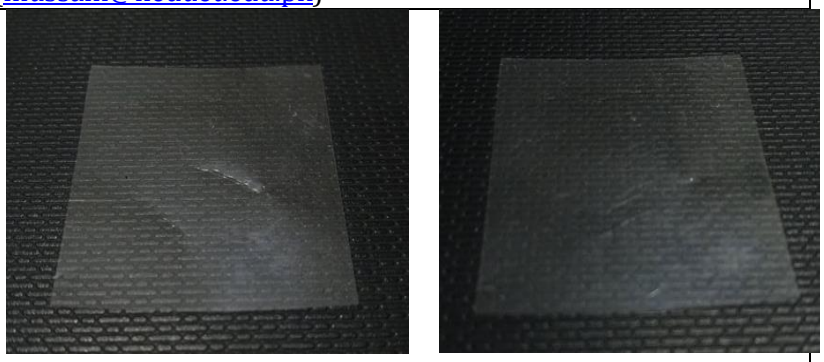
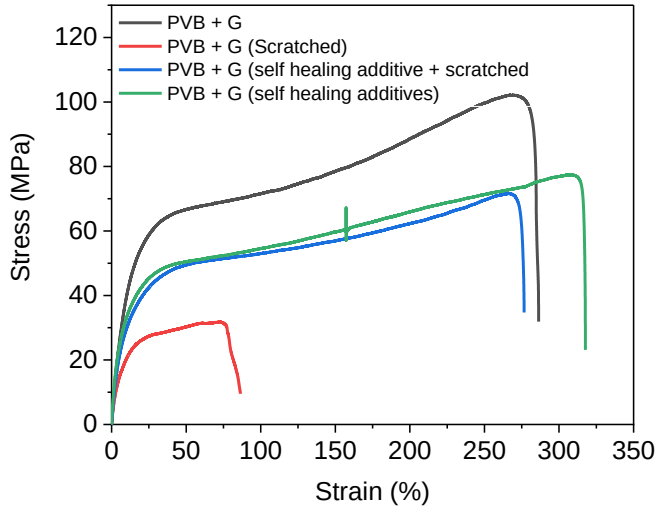
Final Year Project Showcase Batch-2018
Year 2022

Department: Materials Engineering Programme: Materials Engineering		
1	**Project Idea**	Development & Characterization of Superhydrophobic Aand Self – healing Coatings for Engineering Applications
2	**Process**	Solution based blade coating method
3	**Outcome**	Superhydrophobic and transparent Coatings were developed exhibiting self-repairing characteristics against cracks and scratches. Such Coatings can be applied to automobiles, cell phones, laptop cases and solar panels.
4	**Evidence (Theoretical Basis)**	Self-healing materials are those that have the internal capabilities to heal sustained damage on their own or with external stimulation. In automotive underlayment coatings, self-healing films are used. Even on the back of today's smartphones, a self-healing coating is used. Numerous self-healing materials are created by adding substances to pre-existing materials. This is called "extrinsic" recovery. One of the primary reasons for rising automotive maintenance costs is the need to repaint vehicles. If advancements in these self-healing polymeric coatings allow for the creation of paint that can sustain minor scratches as well as resist corrosion, this could have an influence on how much automotive companies must spend on repairs. Something as simplistic as this exhibits the potential to increase the useful life of vehicles.
5	**Competitive Advantage or Unique Selling Proposition** The engineering sector is trying to manufacture novel, super hydrophobic and self-healing films since very long. In this study, hydrophobic films are produced from common polymers such as polyvinyl alcohol (PVA), polyvinyl butyral (PVB), low density polyethylene (LDPE), polydimethyl sulfoxide (PDMS), and polystyrene (PS) by incorporating graphene nanosheets and boric acid into them. The films that have been produced are **super hydrophobic** and possess a unique property of **self-healing**. The hydrophobicity of films was increased by adding graphene and self-healing effect was due to interaction of boric acid into polymeric chains. The production cost of such films is calculated to be around **10 USD/m²**. (The cost is calucated from the consumption of the raw material). The films are highly hydrophobic exhibit a contact angle of around <130° and repair on their own when scratched (As shown in Figure 1 on the last page). Such films have wide applications in the engineering sector such as can be used as a self-cleaning and self repair paint for automobiles, laptop and smart phone covers, a protection agains the hudmidity and scratches is the core issue.	
a	**Attainment of any SDG** (e.g. How it is achieved and why it is necessary for the region)	**SDG#9: Industry Innovation and Infrastructure** We propose hydrophobic coatings that can revolutionise the autmobile industry along with electronic industries. We may drastically reduce the import and can use our own locally developed paints for various engineering applications **SDG#12: Responsible Consumption and Production** The world is facing pollution problems and 30% of the pollution is caused by non-biodegradable plastic paints on different

		applications. Hence we proposed to replace such non-biodegradable paints with biodegradable and green materials so that the overall pollution problem can atleast be controlle **<u>SDG#13</u>: Climate Action** Completely environment friendly and non-toxic coatinngs are syntheized in this project and reducing plastic waste and generating useful properties.
b	**Any Environmental Aspect** (e.g. carbon reduction, energy-efficient, etc.)	As the coatings were developed for engineering applications there are various factors which would help reducing the climate action, such as if the developed coatings are applied on a solar panel it would increase the time it would require a less maintainance efforts. Most of the non-biodegradable paint can also be replaced with these coatings which may result in a low plastic wastage and may improve overall greener environment.
c	**Cost Reduction of Existing Product**	These such coatings are not available in the local market. Our product is ready to use and can be applied on various above mentioned applicable areas. The cost of our developed product is around three times less than commercial and imported product and offer addition self-repairing property.
d	**Process Improvement which Leads to Superior Product or Cost Reduction, Efficiency Improvement of the Whole Process** (e.g. What is the issue is current process and what improvement you suggests)	The aim of the project was not to only develop hydrophobic coatings but also induce a self – healing mechanism into the existing coatings and also improve the adhesion with the substrate. We successful developed the coatings that show all these characteristics, however, the coatings were developed on the lab scale. For high and commercial scale production, a systematic and automated machinery is required. The cost (10 USD/m^2) is expected to be less than 1 USD/m^2 for a commercial scale production with minimum efforts.
e	**Expanding of Market share** (e.g. how it expand and what is the problem with the current market	The current market in Pakistan DO NOT offer these type of coatings that show both hydrophobicity and self-repair properties. We only get products that are imported and they show hydrophic nature. We see a high demand of the self-repair coatings in Pakistan and even in current given conditions we can supply small scale coating sprays to customers along with technical support.
f	**Capture New Market** (e.g. Niche market or unaddressed segment)	As the coatings of these caliber are not produced locally, that is why we have tried to cater to this area which has been unatteneded for so long.
6	**Target Market** (Industries, Groups, Individuals, Families, Students, etc) Please provide some detail about the end-user of the product, process, or service	The targeted market for our coatings are automotive industries and electronic device manufacturers (solar panels). As automotive industries experience corrosion more profoundly than any other therefore they are the main focus for our targeted market. Also the hydrophobic charactertic have the self-cleaning properties and is ideally suited for the solar panels installed on rooftops.
7	**Team Members** (Names along with email address)	1. Syed Muhammad Tayyab Bin Tahir syedmohammadtayyabtahir@gmail.com 2. Wajih Waseem wajihsiddiqui31@gmail.com 3. Muhammad Safwan safwanmuhammad19@gmail.com 4. Munsif Jaweed munsifjaved02@gmail.com

8	**Supervisor Name** (along with email address)	Supervisor: Dr. –Ing. Iftikhar Ahmed Channa (iftikharc@neduet.edu.pk) Co – supervisor: Prof. Dr. Fayyaz Hussain (fhussain@neduet.edu.pk)
10	**Pictures**	 *Figure 1. Lab scale self-healing and super hydrophobic film developed in Thin film. On the left side, free standing hydrophobic coatings is shown with an intended sctrach in the centre. On the right side, same film is shown which self-repaired itself.*  *Figure 2.Tensile strength of lab scale based film,, where red curve represents Scratch PVB+G black curves represent super hydrophobic films and blue graph represent the self-healing film and green line represent the self-healed film after scratch respectively.*