



प्लाज्मा अनुसंधान संस्थान
Institute for Plasma Research

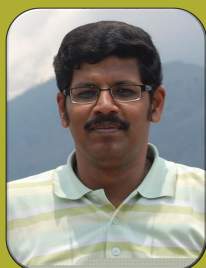
Facilitation Centre for Industrial Plasma Technologies
Institute for Plasma Research

Plasma Processing Update

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G Ravi

Co-Editors



A. Satyaprasad



Kushagra Nigam

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Dr. Vishal Jain
Scientific Officer-F
APD, IPR
vishal@ipr.res.in

Important Highlights

- No water requirement in plasma processing of textile.
- Environment friendly process. No toxic molecule generated during the process.
- No Helium and Argon gas required for processing and hence less operational cost.
- Immediate post processing is possible because no drying of textile is required.

Team Members

- Vishal Jain
- Kushagra Nigam
- Nisha Chandwani
- Adam Sanghariyat
- Nimish Sanchaniya
- S.K. Nema

Design and development of Plasma System for Inline Treatment of Textile

The Atmospheric Plasma Division of IPR has designed and developed a unique plasma system for generating atmospheric pressure streamer free plasma in air using dielectric barrier discharge technique. This activity was financially supported by Department of Science and Technology (DST, New Delhi) and Man Made Textile Research Association MANTRA, Surat.



Figure 1. Plasma System for Inline Treatment of Textile

This plasma system can remove the wax from cotton without using any toxic chemical or water, rendering the process completely dry. Plasma can generate highly active species that take part in the chemical reactions on the surface of the material, thereby improving the surface energy of the material. This is conventionally done using large quantity of water and chemicals in the textile industries. Thus, plasma treatment is an environment friendly process because it does not use or generate any toxic chemical.

In the last few decades, lot of research has been conducted around the world for generating such plasmas particularly in air because it is inexpensive. One of the major challenges in generating such plasmas, however, is to avoid streamer formation. As a result, many industries in the world use Helium or Argon plasma in textile treatment which makes the process very expensive and limits the application to high end textile products.

In recent times, IPR has successfully worked on generating air plasma for inline treatment of textiles. The system was demonstrated to industries during the APTP (Applications of Plasma in Textile Processing) workshop in November 2018.

The generation of this plasma requires a unique power supply architecture patented by IPR (Indian Patent application number 1704/Mum/2014). The technology has also been transferred to a Mumbai based company on non-exclusive basis. In the current project activity, the system can treat 2.5 meter wide textile (cotton, PET film, PP film etc.) at moderate speed. There are multiple pairs of plasma discharges, number of which can be decided based on the type of material to be treated and the treatment speed required. Each plasma discharge is independently powered by an individual low cost power supply.

The experimental work is being carried out at FCIPT to treat various textile for their inline functionality improvement. The functionality improvement on textile surface in one such experiment can be clearly seen in figure 2.

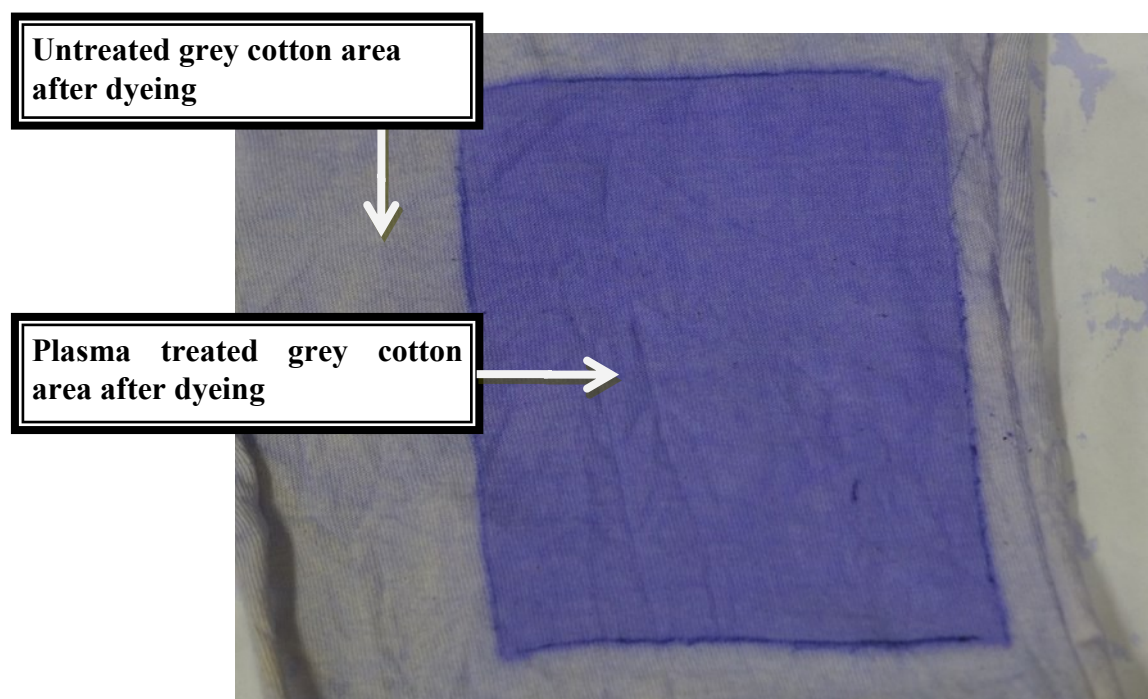


Figure 2. Effect of plasma treatment on grey cotton



Mr. Ramakrishna Rane
Scientific Officer-E
PSED, IPR
ramu@ipr.res.in

Team Members

- Akshay Vaid
- Vijay Chauhan

Development of plasma system for metal deposition on powder

A plasma system for metal thin film deposition on powder substrates has been developed in house. The metal target is sputtered by using low pressure Argon plasma. Metallic thin film deposition up to a thickness of 4 – 5 micron can be carried out using this system. The substrate is water cooled to control the temperature of the powder during the deposition process. Also, the substrate is given vibratory motion in vacuum during the deposition in order to coat maximum surface area of the powder. The system also has potential applications for metal coatings like aluminium, copper and titanium on energetic powder material of sizes 50 – 200 micron. Figure 3 shows the plasma coating system unit during operation.



Figure 3: Plasma based coating system

Past Events

Fusion Energy Conference FEC-2018

IPR hosted the 27th IAEA Fusion Energy Conference (FEC-2018) at Mahatma Mandir during 22-27 October, 2018. In order to showcase various plasma technologies developed by Atmospheric Plasma Division (APD) and Plasma Surface Engineering Division (PSED), a visit to FCIPT campus was arranged for the delegates from 23rd to 25th October, 2018. The delegates visited following facilities at FCIPT campus:

1. Facility for studying anode material erosion of thrusters
2. Plasma nano-patterning laboratory
3. Spacecraft plasma interaction experiments (SPIX) laboratory
4. Atmospheric plasma Jet
5. Plasma nitriding
6. Plasma assisted PVD
7. CZTS based solar cell laboratory
8. Synthesis of nano particles laboratory
9. Inline plasma treatment system for textiles
10. Plasma pyrolysis
11. Plasma torch laboratory

Here are some photographs taken during visit:



CZTS Based Solar Cell Laboratory



SPIX Laboratory



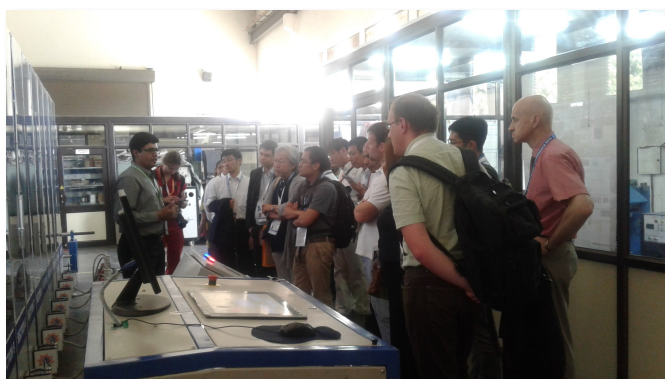
PVD Lab



Pyrolysis Facility

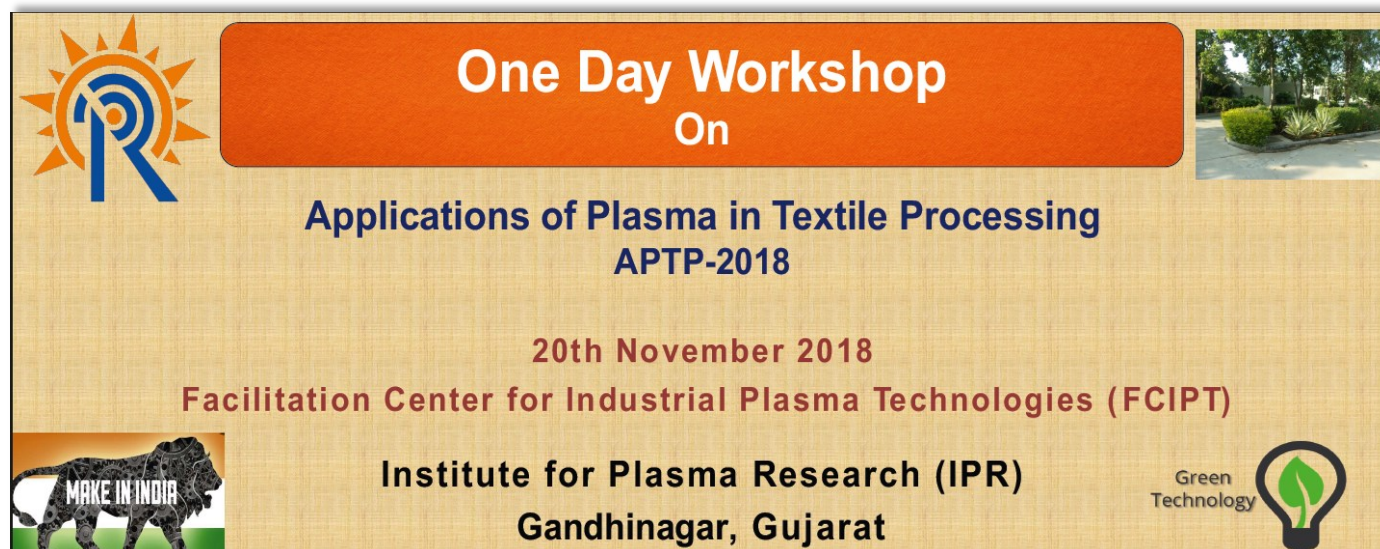


Plasma Torch Lab



Inline plasma treatment system for textiles

One Day Workshop on Application of Plasma in Textile Processing (APTP-2018)



Plasma has great potential for inline processing of various materials used in the textile industry such as the fabric itself, packaging material, paper etc. Plasma produced at atmospheric pressure is especially useful because of the absence of expensive and complex vacuum equipment. It also offers an environment friendly solution for textile processing by doing away with the use of large quantities of water and chemicals conventionally used in such processing.

In this context, a one day workshop on “Applications of Plasma in Textile Processing (APTP)” was organized on 20th November 2018 at the FCIPT campus of IPR. The aim of the workshop was to showcase some of the activities of Institute for Plasma Research, including treatment of fibres to improve cohesion, adhesion and scouring. The workshop also aimed to provide a platform to industries to discuss about the persisting surface treatment problems in the textile industries and identify possible plasma based solutions. The workshop was primarily aimed at industry professionals, entrepreneurs, textile engineering and technology faculties and scientists working in the field of textile research.

After the welcome address by Dean IPR, Shri. U.K. Baruah the inaugural session of the workshop was addressed by the Chief Guest Mr. Rajnikant S. Bachkaniwala, President, Man Made Textiles Research Association (MANTRA), Surat, who was present throughout the workshop till the demonstration of various plasma systems. Other dignitaries at the workshop included, to name a few, Dr. S. K. Basu, Director, MANTRA, Surat, Dr. A. K. Mukhopadhyay, Director, BTRA, Mumbai, Prof. P. B. Jhala from NID Ahmedabad, Dr. (Ms) Krishna Patel from NID, PG Campus, Ahmedabad and Dr. K. C. Gupta from ATIRA, Ahmedabad. The workshop consisted of talks by several speakers and interactions between the participants and speakers. There were participants from textile research associations of Ahmedabad, Surat and Mumbai, DRDO, NID, universities and textile industries.

The inaugural session was followed by the plenary talk by Prof. P. B. Jhala of NID on the status and current trends of plasma technology for textile applications. Other speakers presented their work on plasma treatment of textile including their journey from research to product, limitations, persisting challenges and allied technologies:

- 1) Dr. S. K. Nema from IPR on Textile Treatment using Non Thermal Plasmas : Technologies Developed at FCIPT, IPR
- 2) Shri. Aslam Moolji from Arshad Electronics on Plasma for Plastics and Textile Applications
- 3) Dr. Vishal Jain from IPR on Challenges in Developing Inline Plasma System for Textile Treatment
- 4) Shri. M. G. Parikh from MANTRA, Surat on Dry processing of Man-made Textiles using Plasma
- 5) Shri. Shriram Soni from Inspiron Engineering on Development of Industrial Scale Atmospheric Pressure Air Plasma System to treat Angora Wool
- 6) Prof. Lalita Ledwani from Manipal University, Jaipur on Air Dielectric Barrier Discharge (DBD) Treatment of Textile Polymers to Improve Dye Uptake and Antimicrobial Properties
- 7) Dr. K. C. Gupta from ATIRA on Wet processing of Cotton and Cotton Blended Fabrics
- 8) Dr. Alphonsa Joseph of IPR on Plasma Processing of Textile Components for Enhanced Service Life.

This was followed by a demonstration of plasma systems to the participants of APTP-2018 workshop. Systems demonstrated were the following:

- 1) Plasma treatment system for inline processing of textile (DST/MANTRA funded project).
- 2) Plasma jet system for denim fading.
- 3) Plasma system for nano particle generation.
- 4) Plasma nitriding system for surface hardening of textile components.
- 5) PVD system for metal and metal oxide/nitride coating.

In the end there was a panel discussion in which all the delegates from industry, academia and textile research participated. The participants were informed by Dr. Nirav Jamanpara of Plasma Technology Transfer Section of IPR about how they could get associated in research work with IPR on a particular surface engineering problem in textile industries. There were many techno-commercial queries from industries which the panel experts answered satisfactorily. The general opinion of all was that IPR should frequently organize such workshops to educate industries about the research work carried out at IPR.

Summarily, the workshop covered various topics on plasma applications for hydrophilic functionalization, scouring and de-sizing, adhesion improvement in polymers and textiles, enhancing anti-bacterial properties, self-cleaning fabrics, denim fading, wool treatment for shrink resistance and improvement in service life of textile components using plasma techniques such as nitriding.

Some memories captured during workshop

Photo credits : A. Satyaprasad



Lamp lighting by dignitaries during inauguration session



Welcome Address by
Shri. U.K. Baruah, Dean IPR



Shri. R.S. Bachkaniwala,
President, MANTRA

Welcoming ceremony



Prof. P.B. Jhala, NID



Dr. S.K. Nema, IPR



Shri. Aslam Moolji, Arshad Electronics



Dr. Vishal Jain, IPR



Shri. M.G. Parikh, MANTRA



Shri. Shriram Soni, InspirOn Engg.



Prof. Lalita Ledwani, Manipal University



Dr. K.C. Gupta, ATIRA



Dr. Alphonsa Joseph, IPR

Talks given by various speakers



Various interactions with speakers



Plasma nitriding lab



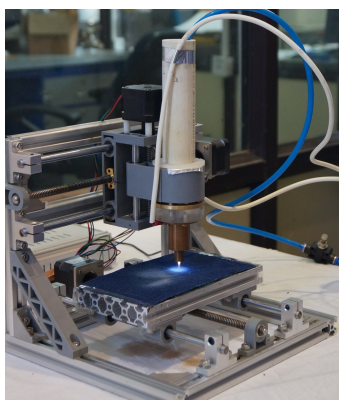
Plasma vapour deposition lab



Inline textile treatment system



Nanopatterning lab



Denim fading using plasma jet



Demonstration of plasma treated samples

Lab visit session



Panel discussion

From Left to Right : Prof. P.B. Jhala, Dr. A. K. Mukhopadhyay, Dr. Nirav Jamnapara. Dr. S.K. Nema




**Group Photo taken during Applications of Plasma in Textile Processing
(APTP-2018) workshop**

“Plasma for a Sustainable Tomorrow”

For more details visit us at:

Facilitation Center for Industrial Plasma Technologies
Institute for Plasma Research
A-10/B, Electronics Estate, GIDC, Sector-25
Gandhinagar, Gujarat, India

 079-23269033 / 17

 fcipt@ipr.res.in

 www.plasmaindia.com