The 6th International Conference on Nanogenerators and Piezotronics
NGPT 2022 20 – 23 June
hosted by FSCN reseach centre Mid Sweden University Sundsvall

Role of elastic modulus in triboelectrification of identical P(VDF-TrFE) polymers

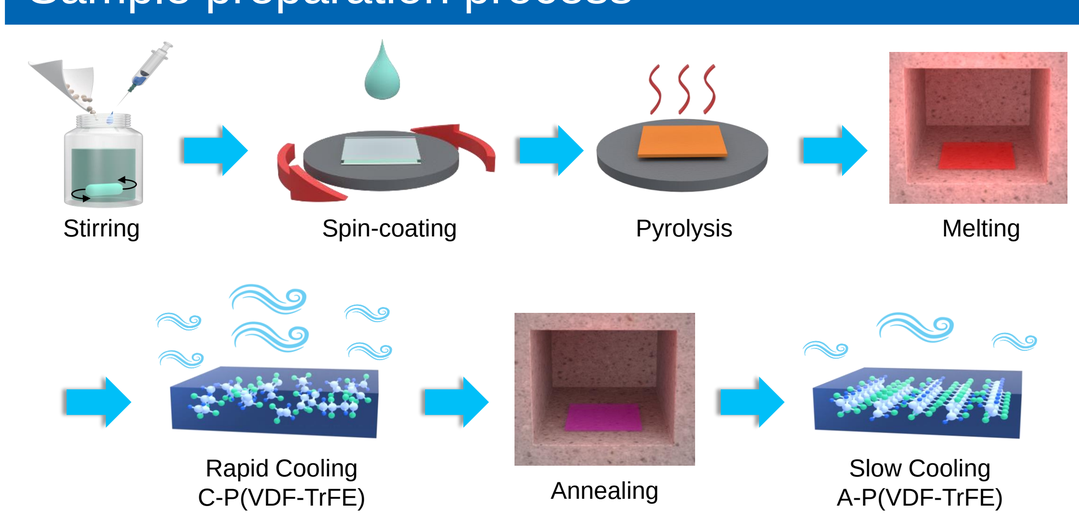
Dong Geun Jeong[1], Young Joon Ko[1], Dae Sol Kong[1], Dong Woo Lee[1], and Jong Hoon Jung*,[1]

[1]*Department of physics, Inha University, Incheon 22212, Republic of Korea*

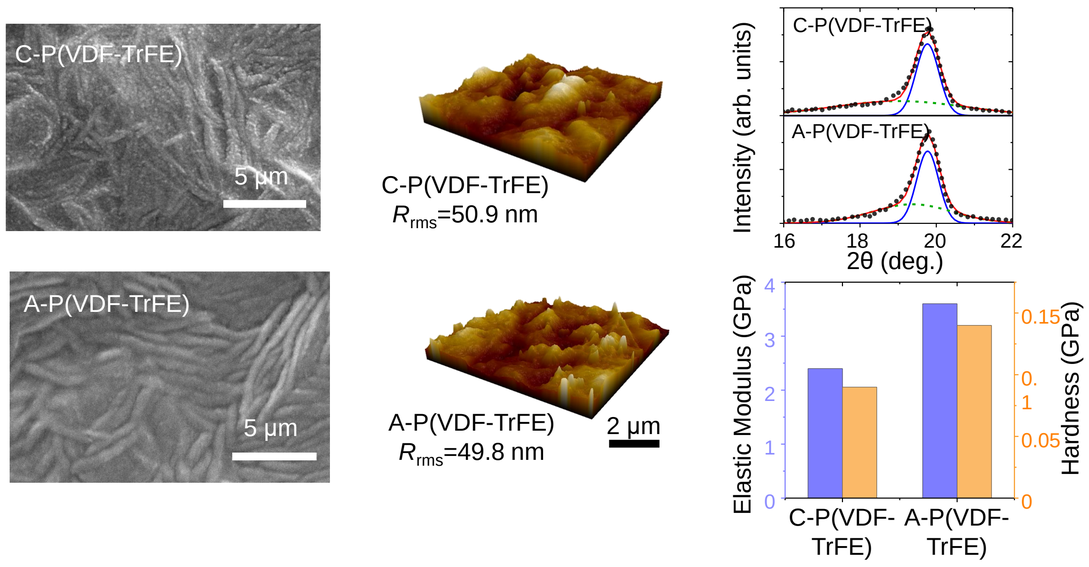
Abstract

- As the demand for charging portable and wearable electronic devices increases, energy harvests from mechanical vibrations wasted in everyday life have attracted considerable attention. However, we still don't understand the fundamental mechanisms of triboelectrification.
- C- P(VDF-TrFE) had sparse particles, small elastic modulus and surface charge density, while A- P(VDF-TrFE) had dense particles, large elastic modulus and surface charge density.
- When the polymer comes into contact with the ITO electrode, the triboelectric output of C- P(VDF-TrFE) was greater than that of A-P(VDF-TrFE).

Sample preparation process

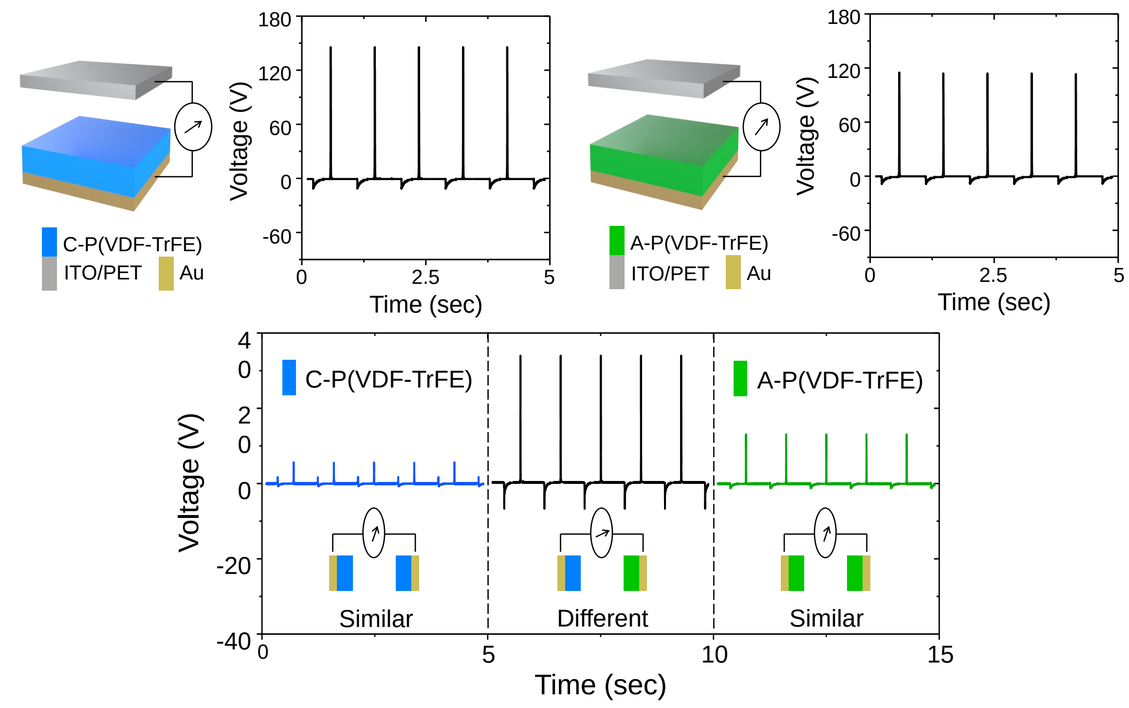


Sample Charactreristics



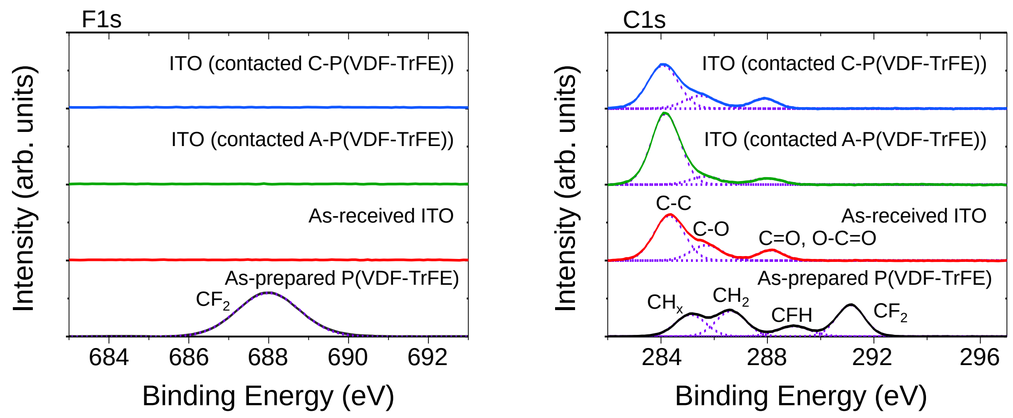
- The grain size was larger in the A-P (VDF-TrFE) sample and the **crystallinity was also higher**, but **the roughness was similar**.
- The elastic modulus is also larger in sample A-P(VDF-TrFE) than C-P(VDF-TrFE), as shown in the figure.

Triboelectric Result



- Trivo Electric results show that the output from **CPVDF-TrFE**, which has a small elastic modulus, was **slightly larger in the contact of ITO**.
- In the contact of the same PVDF-trFE, the same modulus had a smaller output, but we confirmed that **the output from different modulus was larger.**

XPS Result



- Intriguingly, we could not observe any peaks in F1s XPS spectra of ITO, contacted C-P(VDF-TrFE) and A-P(VDF-TrFE). These results should imply that any materials within the **P(VDF-TrFE) films did not move to ITO**
- Since ITO has a significantly larger elastic modulus than P(VDF-TrFE), **the absence of material-transfer between ITO and P(VDF-TrFE)** should also imply the absence of material-transfer between the two P(VDF-TrFE) polymers

Summary

- **In summary**, we have investigated the origin of triboelectrification behavior of identical P(VDF-TrFE) polymers.
- The C-P(VDF-TrFE) had low elastic modulus and large surface charge density, while the A-P(VDF-TrFE) had high elastic modulus and small surface charge density.
- **We could not observe any trace of P(VDF-TrFE) in ITO** after numerous contact-separation events, which contradicts a recent claim
- We proposed that **roughness-induced frictional heat and elastic modulus differences** may play an **important role for the minute material and/or ion transfer** in the triboelectrification of identical P(VDF-TrFE) polymers.