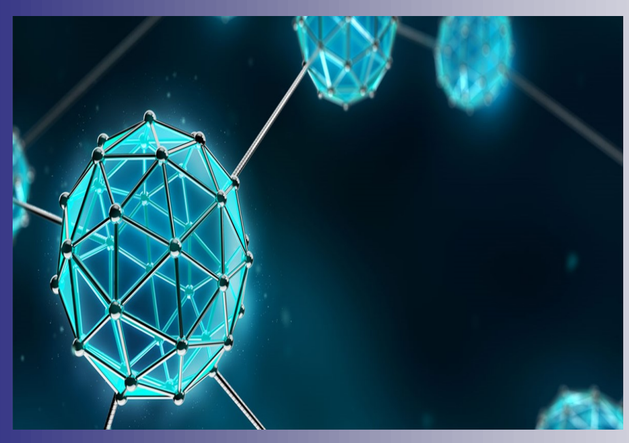
BURSA ULUDAG UNIVERSITY
FACULTY OF
ENGINEERING
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

"The interface is the device."
Herbert Kroemer

Breakthrough to Improve Lifespan of Electronic Devices

Given that we are undergraduate students in the Division of Electrical and Electronics Engineering in the Faculty of Engineering, in this academic poster, after reading and discussing the research article on 12 April 2021 titled "**Direct observation of nanoscale dynamics of ferroelectric degradation" (published in *Nature Communications,* in April 2021)** in Vocational English course that has been co-ordinated by Dr. Neslihan Onder-Ozdemir, we are willing to share our opinions in light of this current research article.



REPORTERS: Abdoulaye DIARRA, Büşra Şevval TÖNBOL, Furkan ÖZBEK, Orhan ÖZKAN

DESIGNER: Büşra Şevval TÖNBOL

REVIEWERS: Muhammet BAYRAKTAR, Esad BAL

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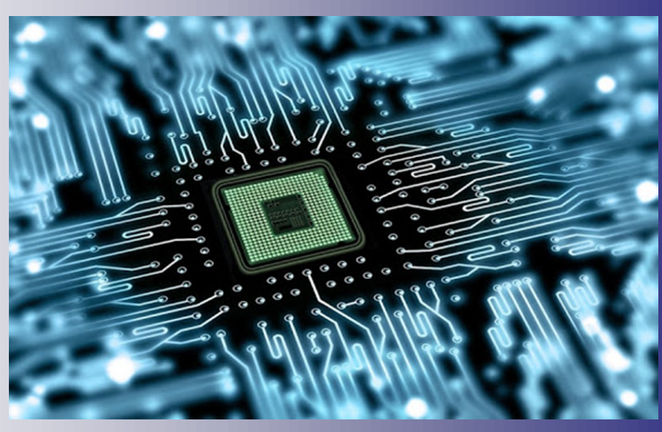
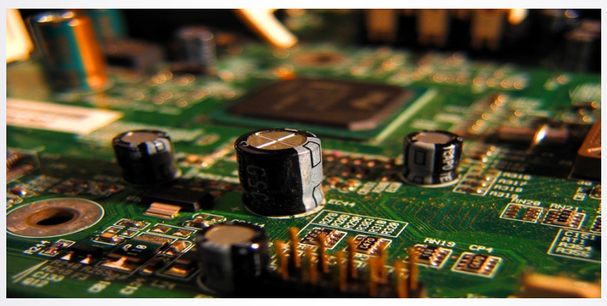


We should note that while we were reading this current research article on ferroelectric materials, we were very happy because we are already familiar with the term *ferroelectric materials* from our course titled *Electrical Materials*, which has been co-ordinated by Assoc. Prof. Dr. Sait Eser KARLIK and his assistant Oğuzhan COŞKUN and Dr. Abdurrahman GÜNDAY. Thus, in the Vocational English course this term, when Neslihan Hoca asked whether we are familiar with this term (she always asks), we willingly wrote to the chat in google meet that during the *Electrical Materials* course, we have already learnt that materials can have a spontaneous electric polarization with ferroelectricity and ferroelectric materials have been widely used in electronic nanodevices. Ferroelectricity, property of certain nonconducting crystals, or dielectrics, that show spontaneous electric polarization (separation of the centre of positive and negative electric charge, making one side of the crystal positive and the opposite side negative) that can be reversed in direction with a proper electric field application.

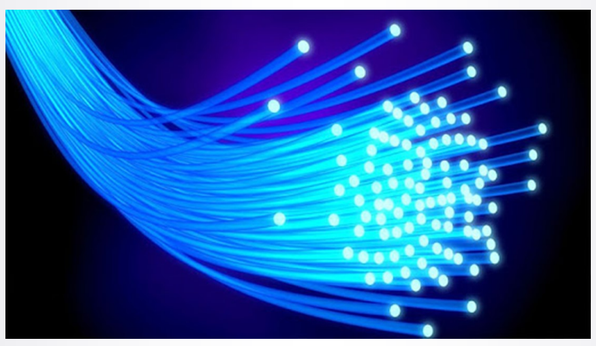
Ferroelectric materials are crystalline materials that exhibit spontaneous electrical polarizations switchable by an external electric field. We can use ferroelectric materials in many devices with several applications, such as actuators, capacitors, oscillators, thermistors, sensors and filters.



We were familiar with this term; however, we were not aware of the current studies and gaps, so this research article took our interest considerably which was written by Qianwei Huang, Zibin Chen, Matthew J. Cabral, Feifei Wang, Shujun Zhang, Fei Li, Yulan Li, Simon P. Ringer, Haosu Luo, Yiu-Wing Mai and Xiaozhou Liao.

We are aware that millions of tons of electronic devices are in waste each year. In their research article, Huang et al. used the term 'ferroelectric fatigue" to echo that ferroelectric materials are exposed to recurring mechanical and electrical loading, which causes a progressive decrease in their functionality and becomes useless. They highlighted the challenges we face because of the failure of polarization reversal, i.e., ferroelectric degradation, which may affect the application of ferroelectrics in devices negatively where reliability is critical. Thus, Huang et al. focused on observing ferroelectric fatigue when it happened. *They seem to fill a gap in engineering because although engineers are aware that ferroelectric fatigue may decrease the lifespan of electronic devices, until this study, it has not been understood how this happens because of a lack of proper technology to observe it*. **They have used advanced in-situ electron microscopy to observe.** They highlight that interfaces may accelerate ferroelectric degradation. Thus, if, as candidate engineers, we aim for the best performance, we should understand these processes better.

If you are interested, the authors stated that the data supporting the findings of their study are available within this open access research article, which is seven pages, and its supplementary information files, you can obtain using the reference on the left side of the picture.



References

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Qianwei Huang, Zibin Chen, Matthew J. Cabral, Feifei Wang, Shujun Zhang, Fei Li, Yulan Li, Simon P. Ringer, Haosu Luo, Yiu-Wing Mai, Xiaozhou Liao. **Direct observation of nanoscale dynamics of ferroelectric degradation**. *Nature Communications*, 2021; 12 (1) DOI: 10.1038/s41467-021-22355-1