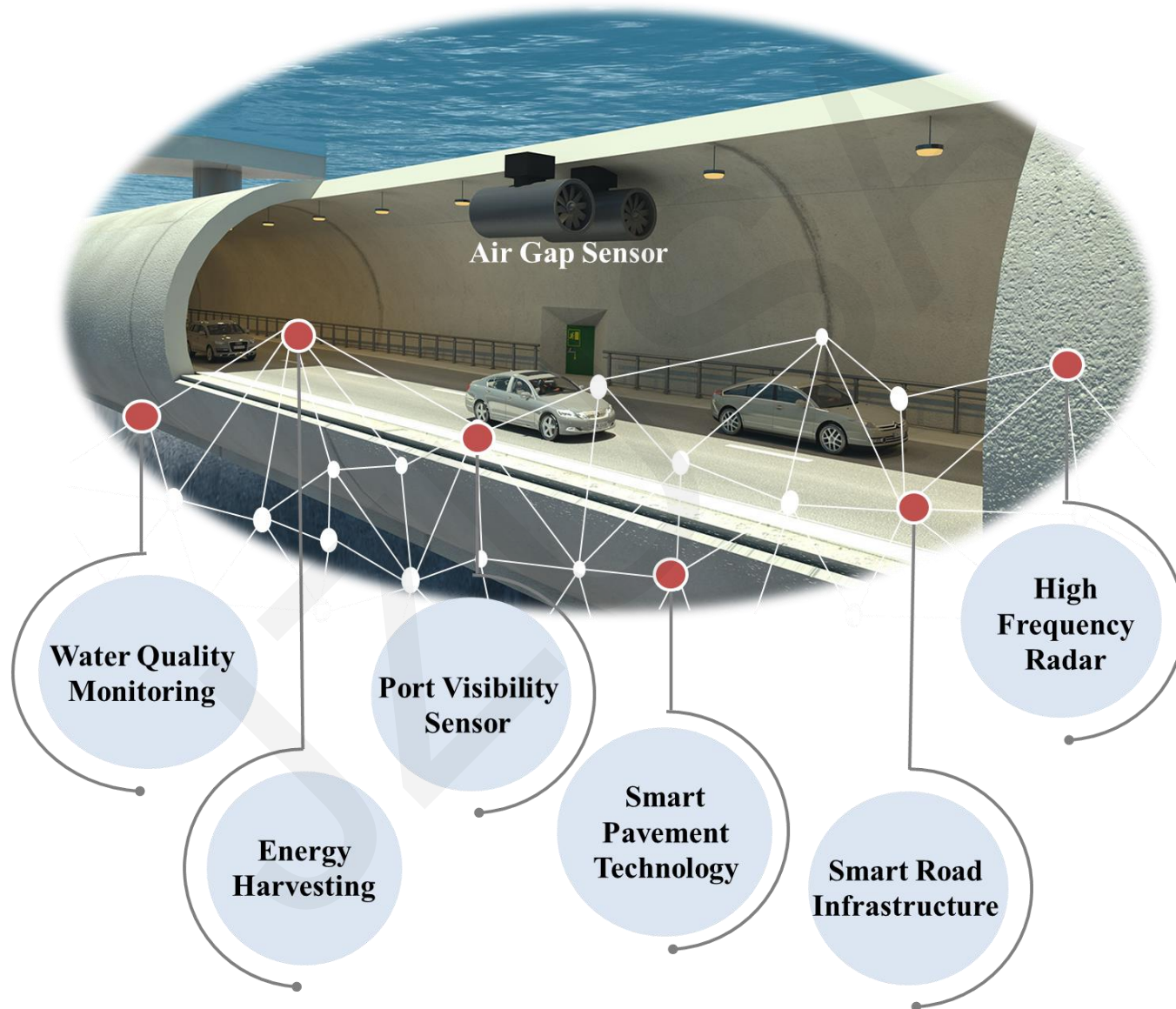


# **Coastal bridge infrastructure: energy-harvesting and sensing capabilities through magnetic structured triboelectric nanogenerators**

Ali MATIN NAZAR, Arash RAYEGANI, Maria RASHIDI, Fatemeh RAHIMI SARDO

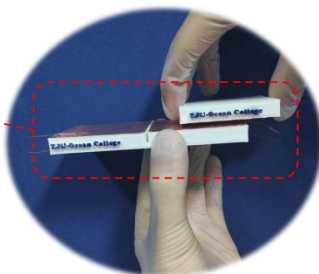
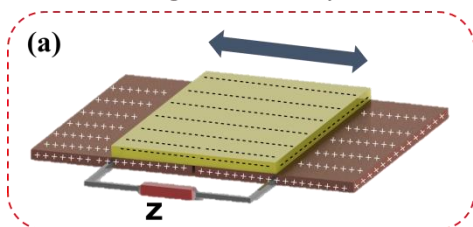
Cite this as: Ali MATIN NAZAR, Arash RAYEGANI, Maria RASHIDI, Fatemeh RAHIMI SARDO, 2025. Coastal bridge infrastructure: energy-harvesting and sensing capabilities through magnetic structured triboelectric nanogenerators. *Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)*, 26(6):540-557. <https://doi.org/10.1631/jzus.A2300231>

# Intelligent coastal infrastructure

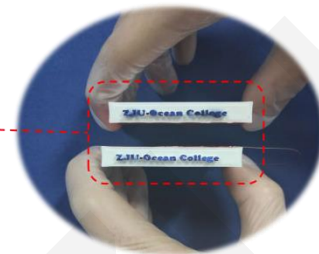
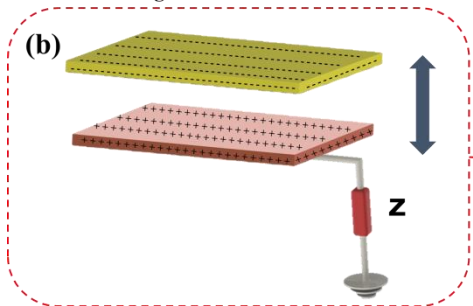


# Four modes of triboelectric nanogenerators

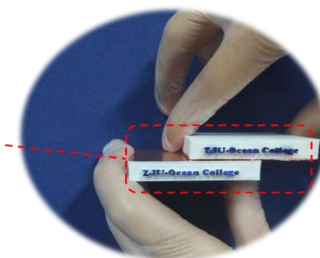
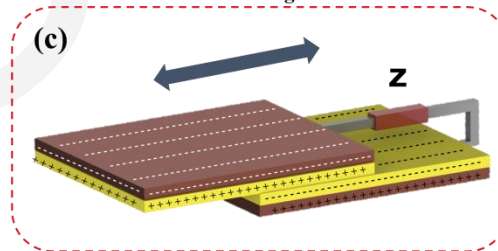
Freestanding Triboelectric Layer Mode



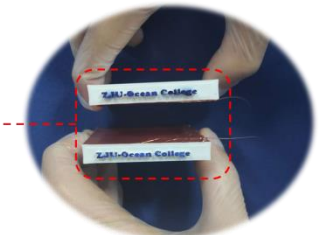
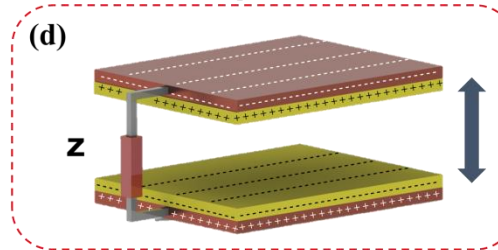
Single Electrode Mode



Lateral Sliding Mode

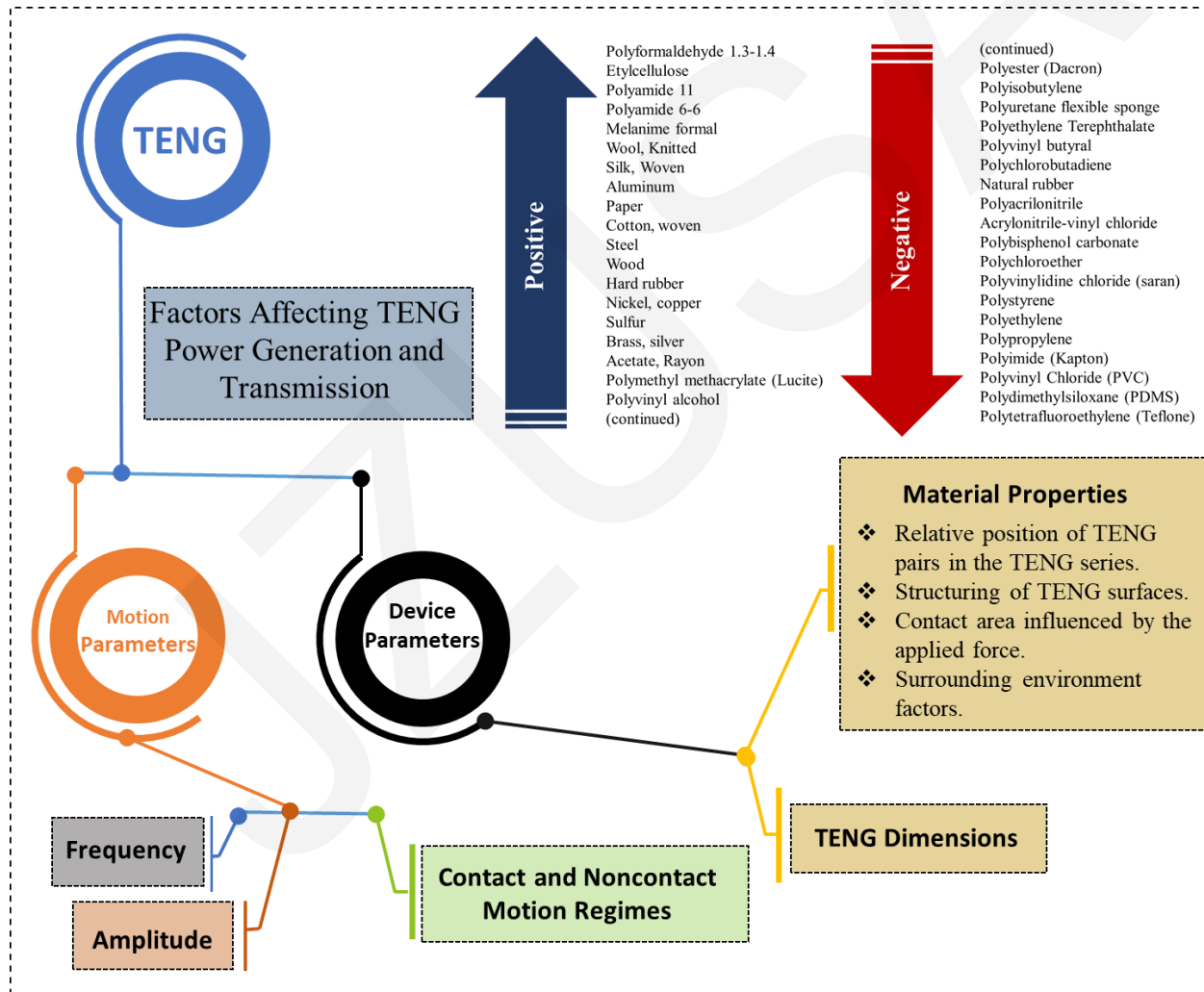


Contact Separation Mode

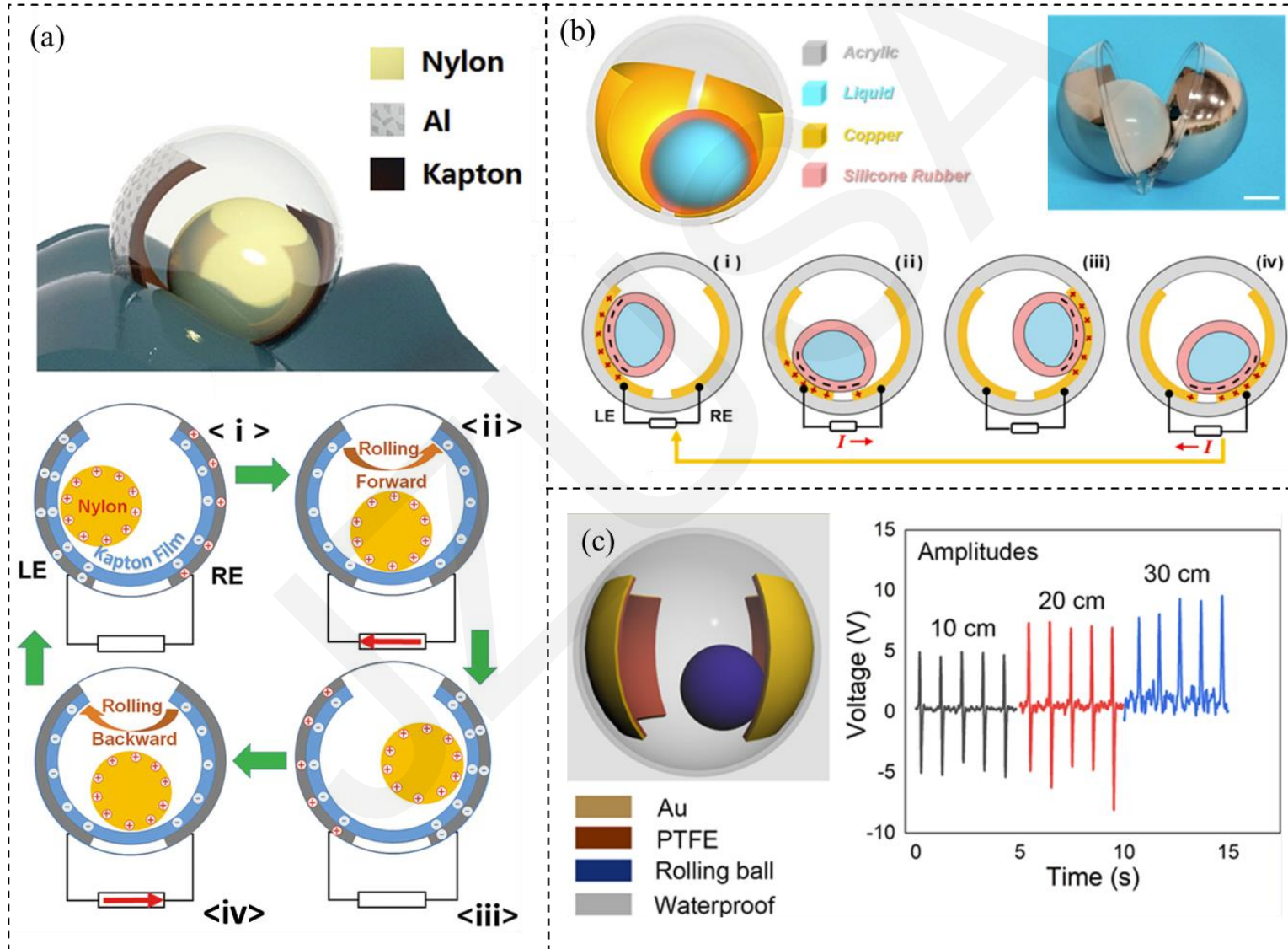


Dielectric Material Electrode

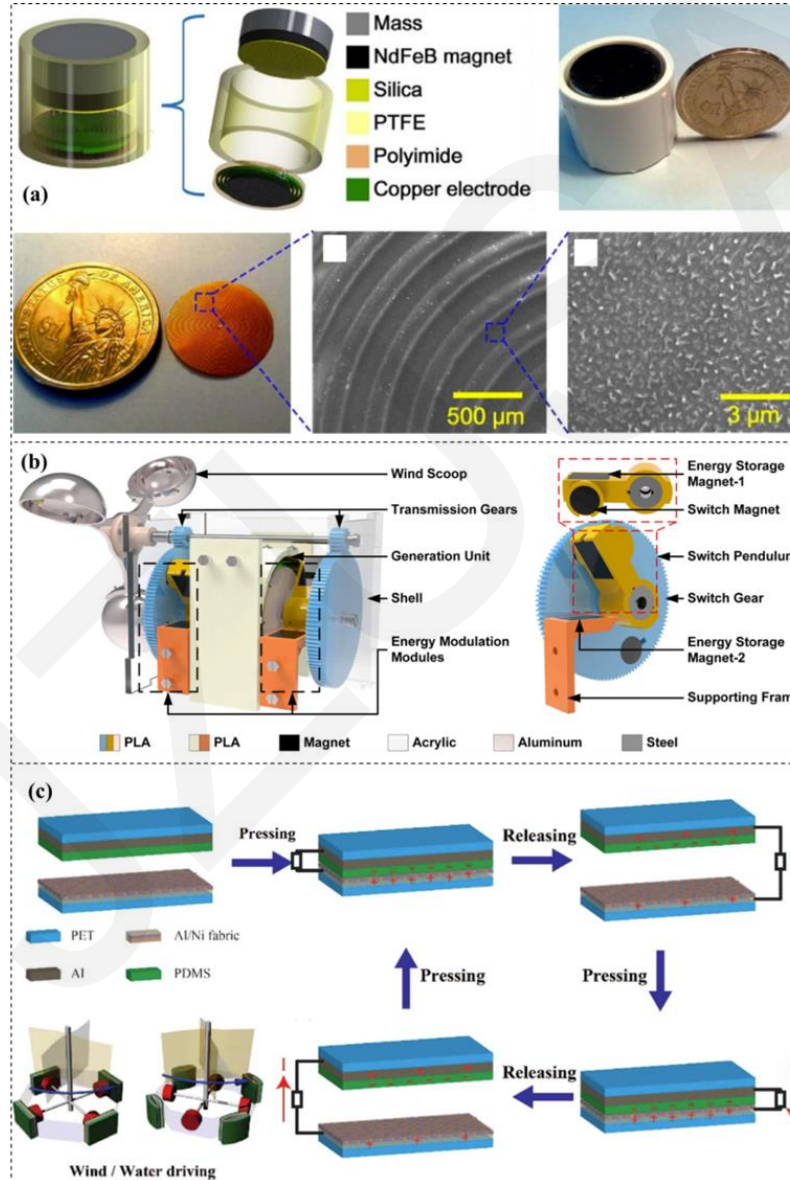
# Triboelectric series and Factors affecting TENG power generation and transmission



# Magnetic Spherical Triboelectric Nanogenerator Networks



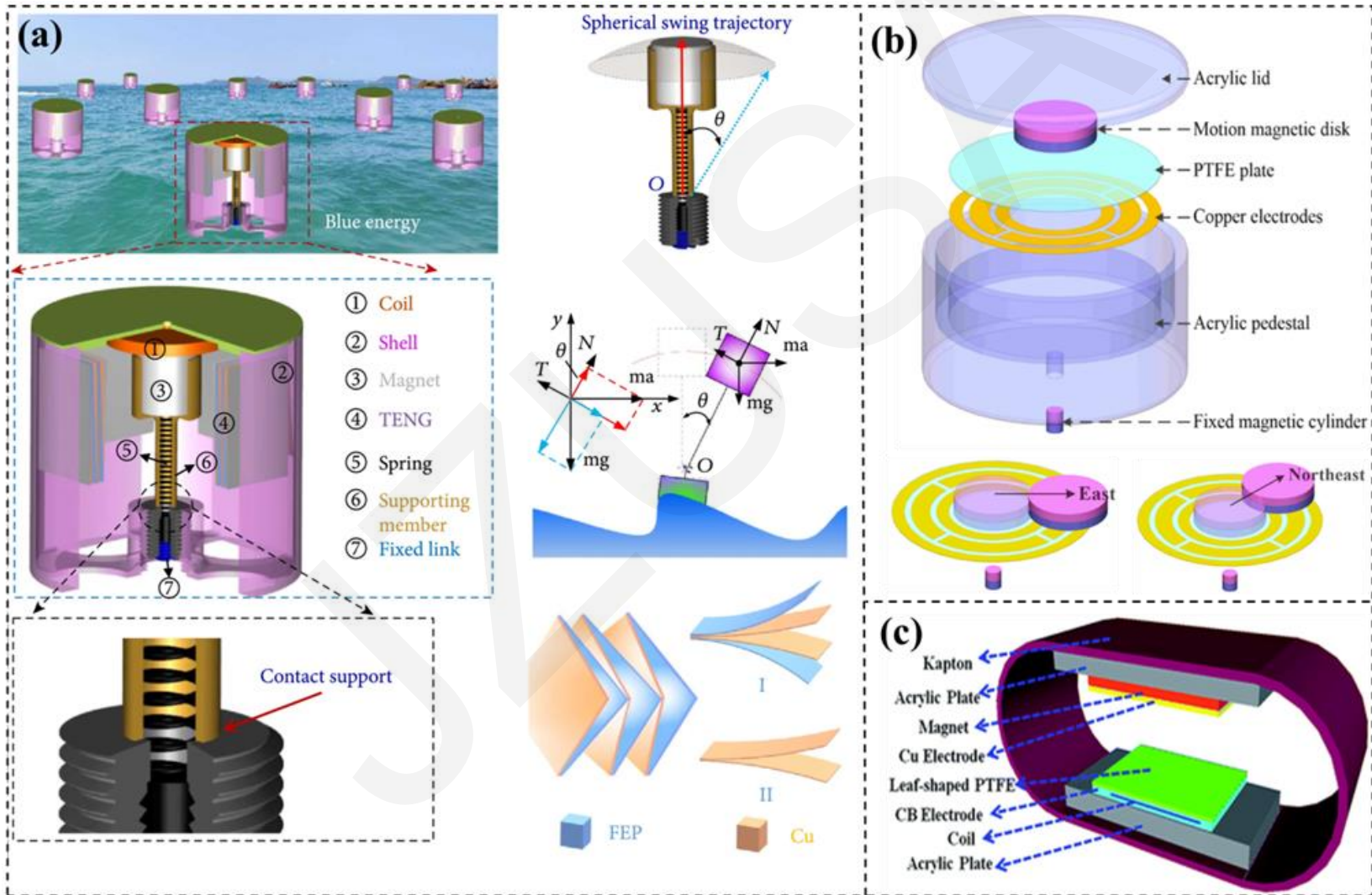
# Magnet-Assisted Triboelectric Nanogenerator



# Magnetic Structured Triboelectric Nanogenerators for bridge

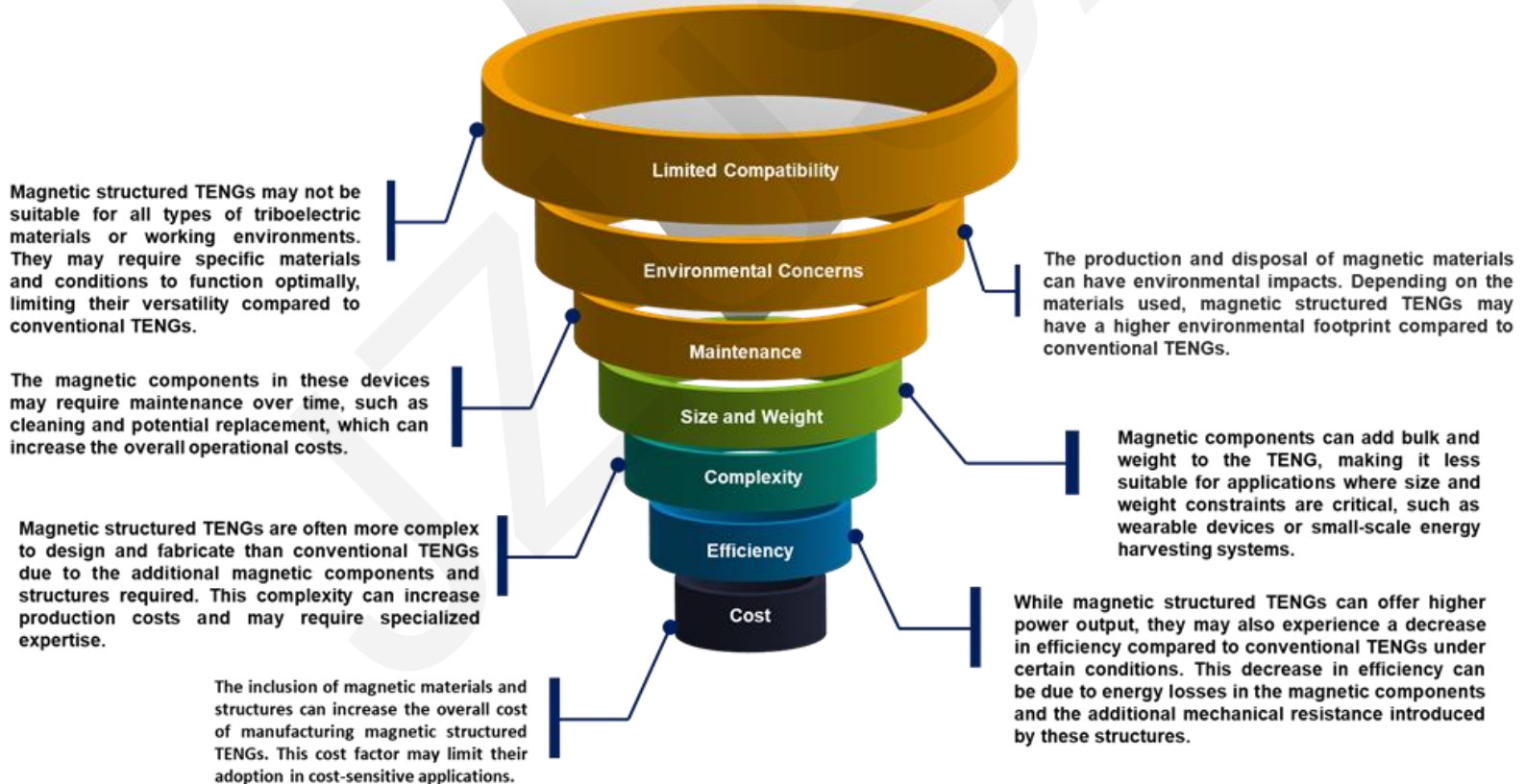


# Magnetic Multilayer structure based on the Triboelectric Nanogenerators



# Assessing Magnetic Structured TENGs in Comparison to Conventional TENGs

## DISADVANTAGES OF MAGNETIC STRUCTURED TENG VS. CONVENTIONAL TENG



# Conclusions

In conclusion, magnetic structured triboelectric nanogenerators (MSTNGs) have emerged as a promising technology for energy harvesting and sensing in coastal bridge infrastructure. This paper reviews recent advancements, covering fundamental physics and various types of MSTNGs, including magnetic spherical TENG networks, magnet-assisted TENGs, and magnetic multilayer structures. Significant progress has been made in optimizing these devices, but challenges remain in improving their durability, sustainability, and power output in harsh coastal environments. Collaboration between academia, industry, and government is essential for future advancements in MSTNG design and application.

