Multi-pin Corona Poling Rotating System for ME Electret Sensors

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Introduction

Electrets support a wide range of applications such as MEMS, electret microphones, air filters, electret motors, blood-compatible electrets, radiation dosimeters and especially magnetoelectric sensors as the main focus of the present paper [1-3]. A new concept of magnetoelectric (ME) sensors consists of two elements including a negative PTFE electret film and a magnetoactive layer. This combination allows to transduce the deformation caused by a magnetic AC signal into an electrical signal (Fig.1) [1].

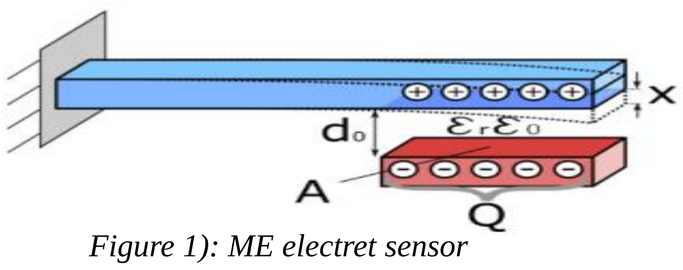


Figure 1): ME electret sensor

Recently, a modified single point-to-plane corona poling rotating system (hereafter called old system) has been reported for corona electret production (Fig.2) [2,3].

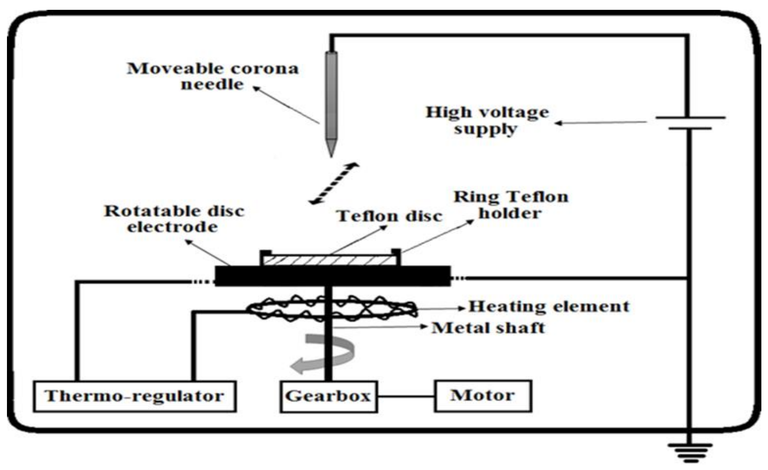


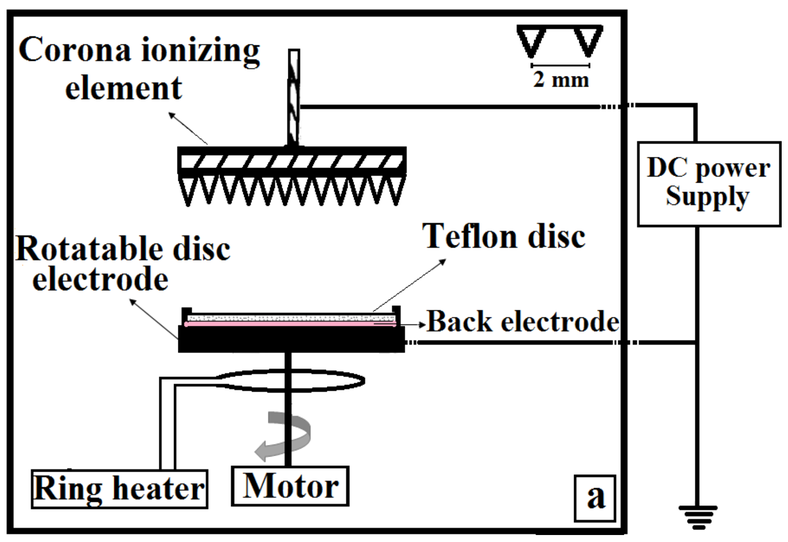
Figure 2): Modified single point-to-plane corona poling rotating system .

Limitations in the old system to increase the charging efficiency for ME sensors in case of;

1. Charging of multiple electrets at the same time.
2. Higher charging speed
3. Higher surface potentials on the electret.
4. Higher charge stability
5. Simpler system geometry with lower cost.

Results and Discussion

A "multi-pin corona poling rotating system" (hereafter called new system) is successfully developed to produce multiple electrets, which could be used e.g. in ME Sensors (Fig.3a,b). A fixed multiple-needle electrode as ionizing element deposits corona ion flux onto a heatable rotational disc electrode with a PTFE disc placed in its center (Fig.3a).



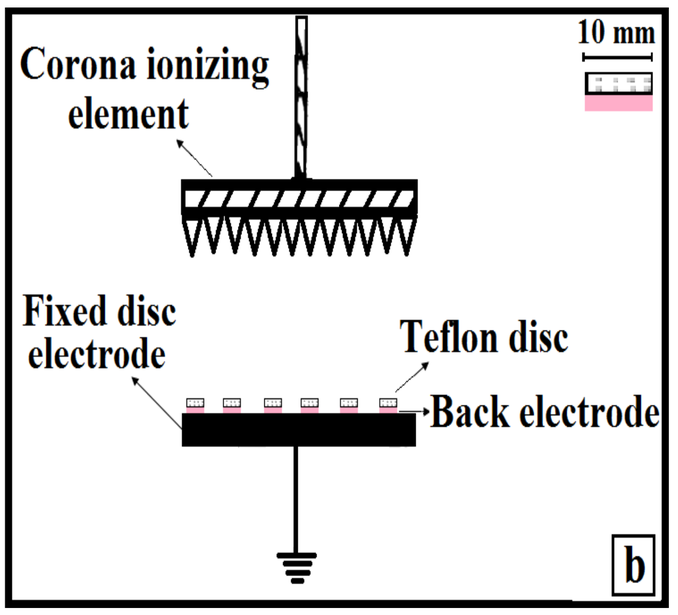


Figure 3): Schematic diagrams of new system in two modes: (a) large-area electret, (b) multiple small electrets.

The new system has another operation mode which allows to simultaneously produce multiple small electrets during one charging cycle simply by fixing the disc electrode (Fig.3b).

As seen in Figure 3c;

1. Charging speed in the new system is faster than in the old system which allow to produce larger number of electrets in one or multi charging cycles.
2. New system deposits a higher surface potential on the electret during an equal charging period which is an effective advantage for making ME sensors with stronger output signals [1].

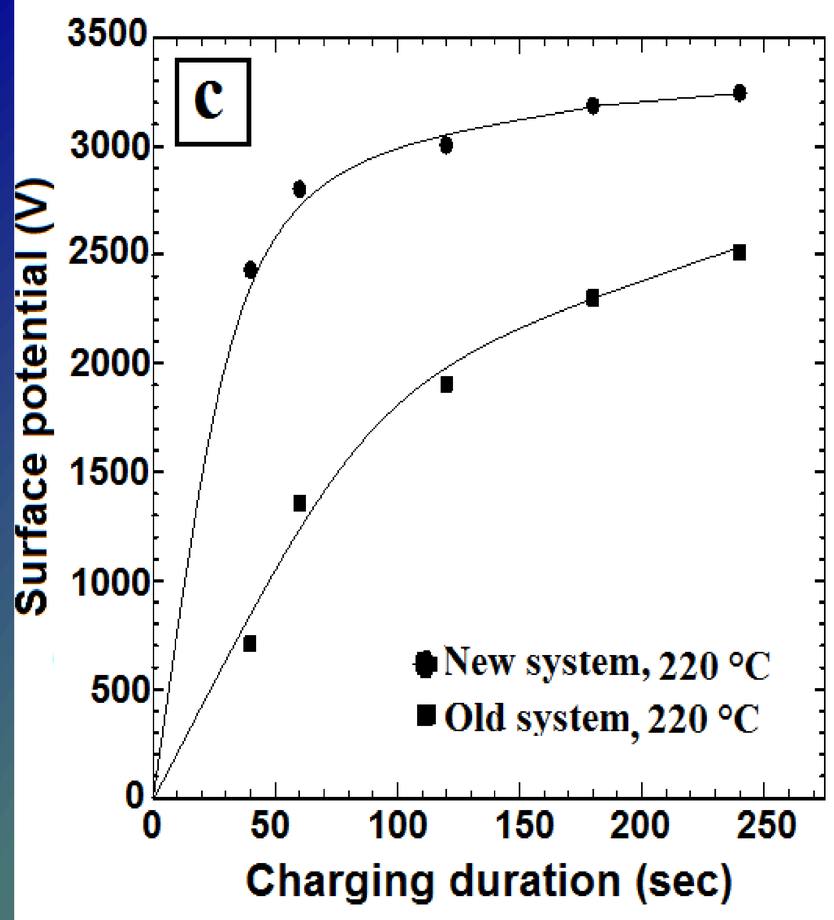


Figure 3): (c) Surface potential build-up of PTFE (1 mm thick, 6 cm diameter) for old and new system.

According to Figure 3d;

1. PTFE discs charged at room temperature by using the new system shows better charge stability in comparison with PTFE discs formed based on the old system due to generation of more energetic corona ions.
2. A further enhanced charge stability of the electret can be achieved by producing electrets at elevated charging temperature in the new setup.
3. Therefore, sensors with lower burst noise due to lower electret charge decay might be produced by using the new system.

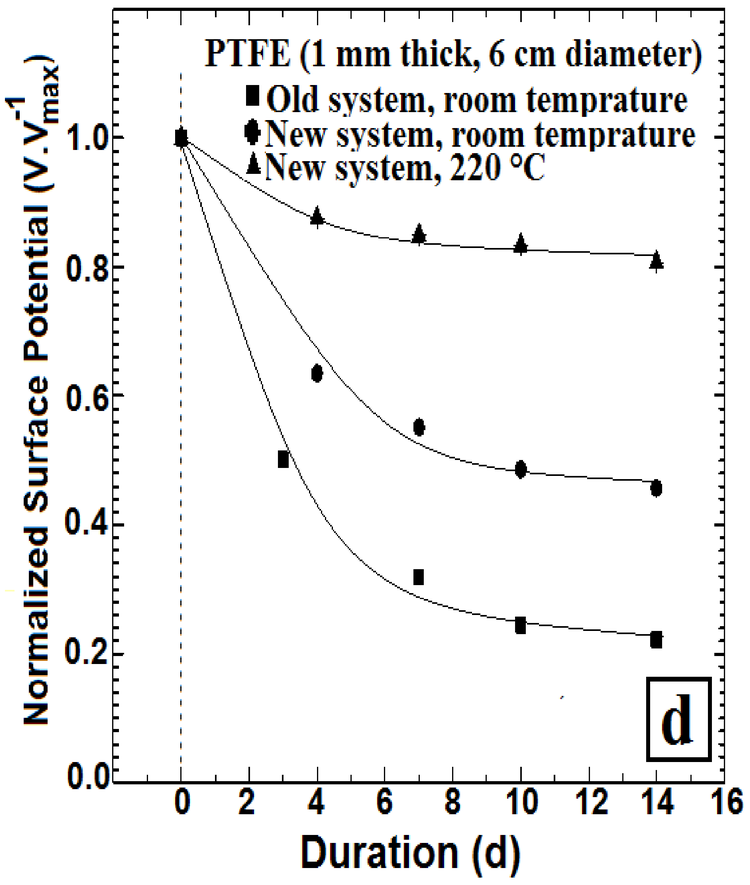


Figure 3): (d) potential decay of PTFE electrets produced by using old and new systems charged up to 2.5 kV.

Conclusion

The new system has some superior characteristics that make it more efficient for electret production especially for ME electret sensor applications with regard to;

1. Higher charging speed.
2. Higher electret surface charge potential.
3. Ability to produce larger numbers of electrets in different sizes.
4. Higher electret charge stability.
5. Much simpler geometry at lower cost.

Acknowledgements

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References

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