Electronic Supplementary Material (ESI) for Soft Matter.

Supplementary Information for

Finite-size effect on the percolation and electromechanical behaviors of liquid metal particulate composites

Mohammad Madadi, Pu Zhang[1]

Department of Mechanical Engineering, State University of New York at Binghamton, Binghamton, NY 13902, United States

List of Supplementary Documents:

[1] Corresponding author. Email: pzhang@binghamton.edu

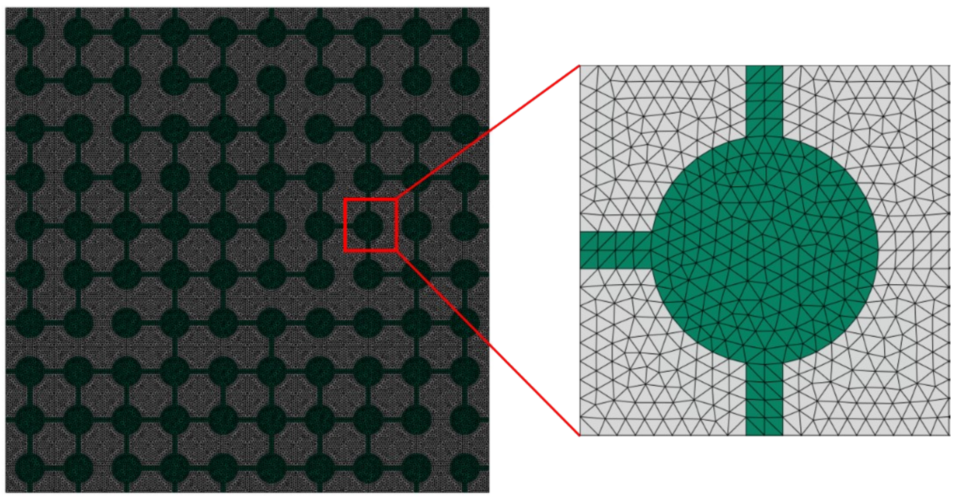

Figure S1. A typical finite element model of the composite with 10*10 unit cells. The representative unit cell on the right side has three open channels (conductive) and one closed channel (insulated). We use green color for liquid metal and grey for the elastomer matrix.

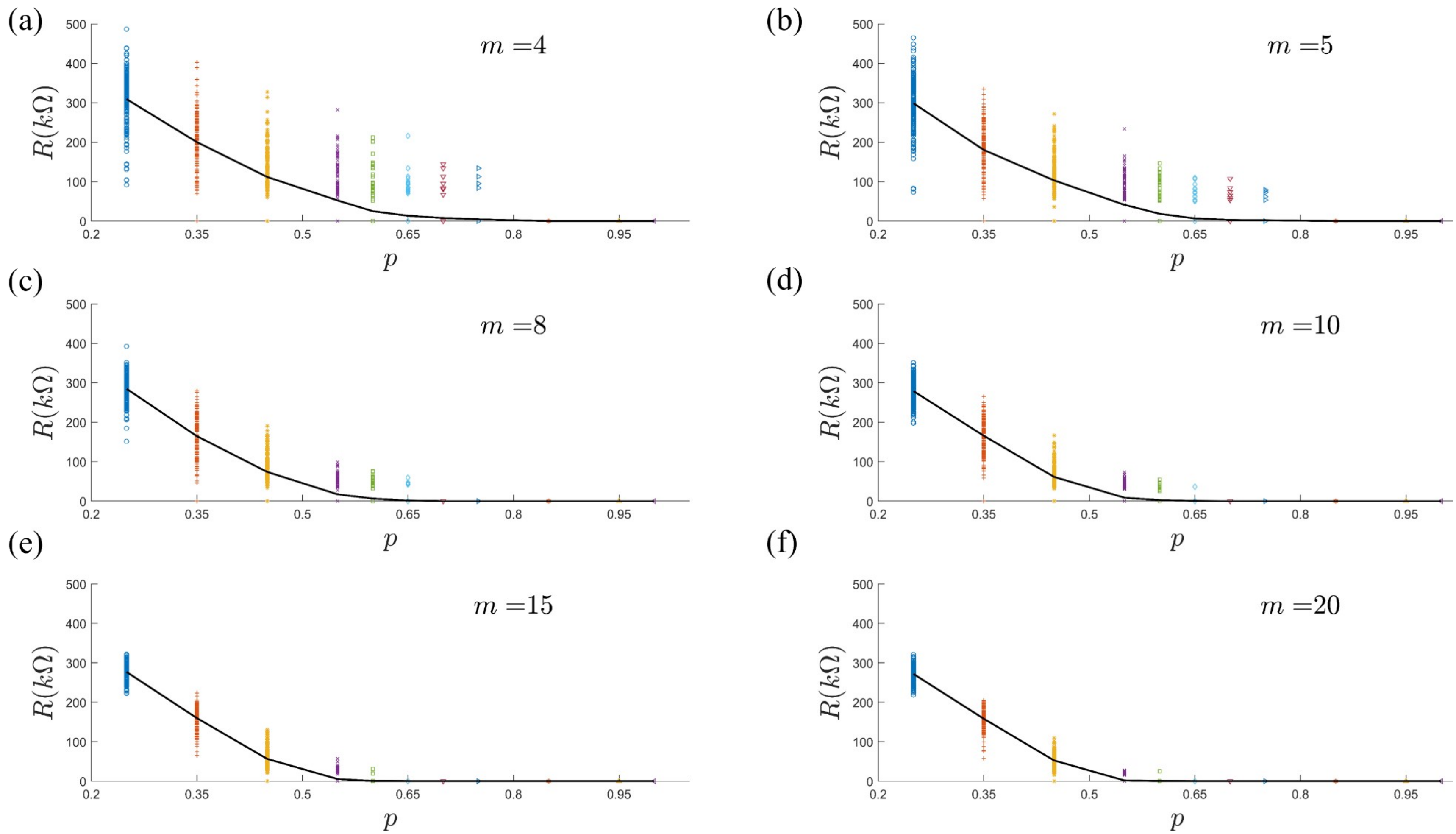

Figure S2. Electrical resistance *R* versus percolation probability *p* for 170 square samples with different sizes *m***m*. The markers indicate the resistance data while the solid lines indicate the mean resistance.

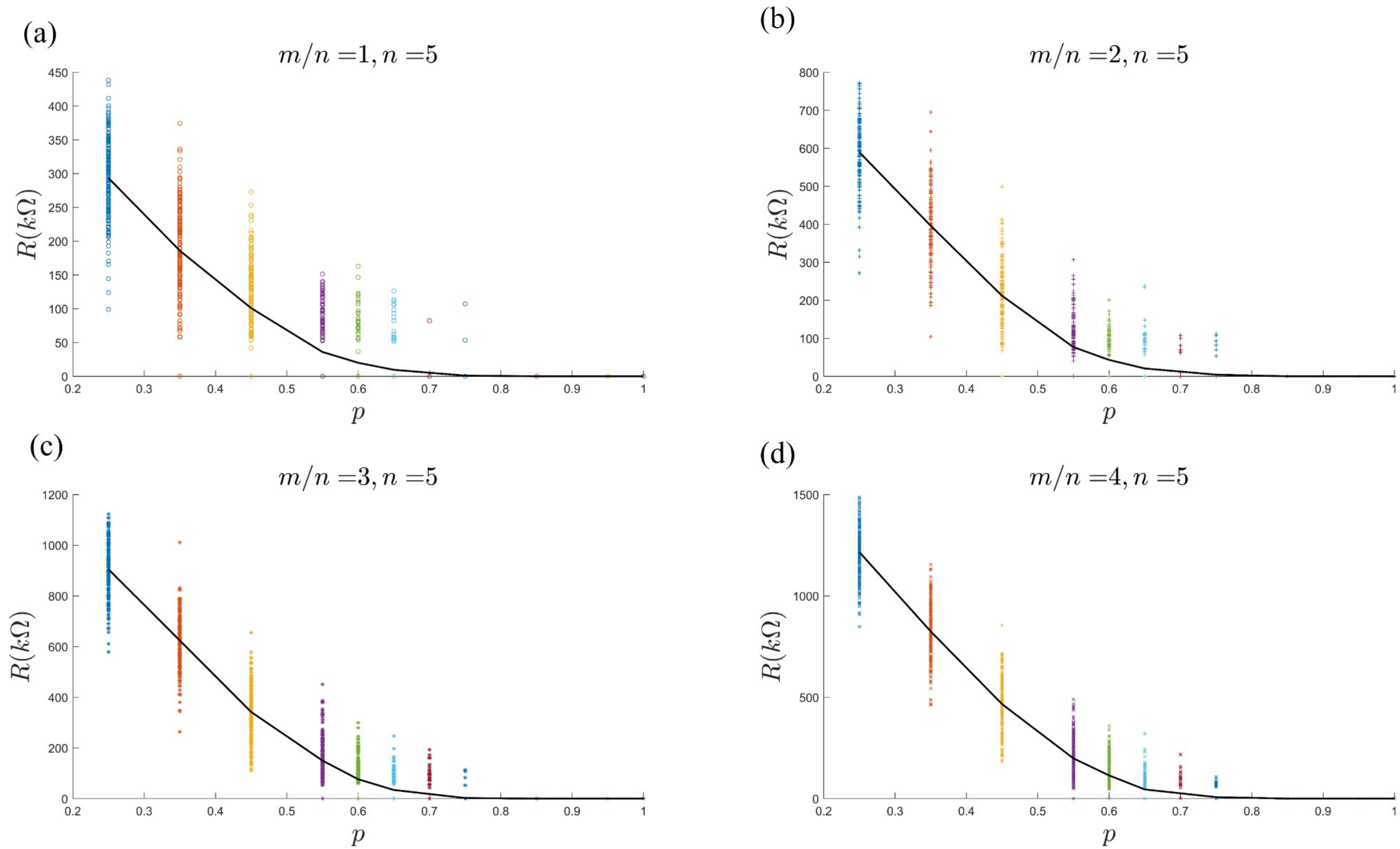

Figure S3. Electrical resistance *R* versus percolation probability *p* for 170 rectangular samples with *n*=5 unit cells in width and different aspect ratios: (a) *m*/*n*=1, (b) *m*/*n*=2, (c) *m*/*n*=3, (d) *m*/*n*=4. The markers indicate the resistance data while the solid lines indicate the mean resistance.

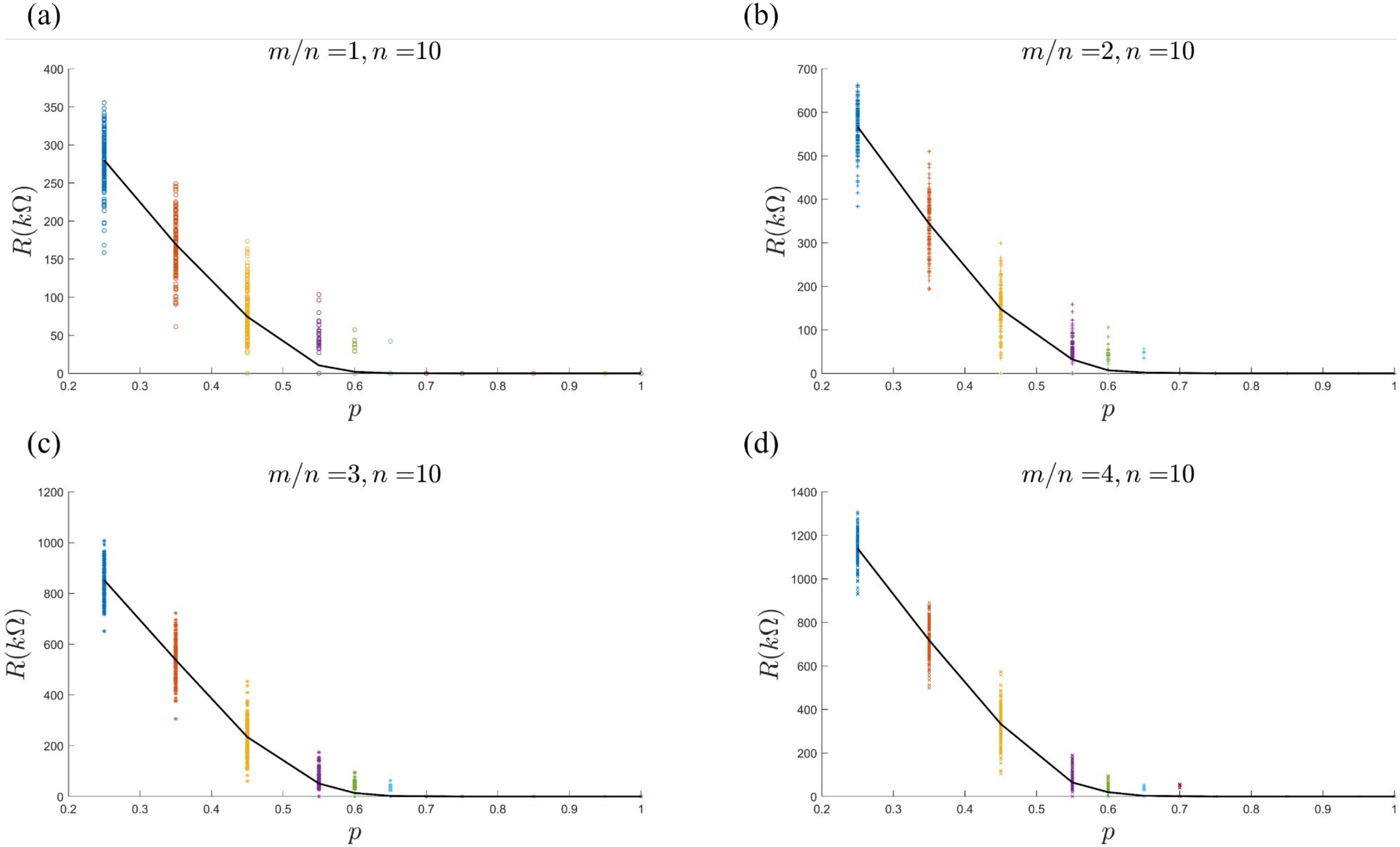

Figure S4. Electrical resistance R versus percolation probability p for 170 rectangular samples with 10 unit cells in width and different aspect ratios. (a) m/n=1, (b) m/n=2, (c) m/n=3, (d) m/n=4. The markers indicate the resistance data while the solid lines indicate the mean resistance.

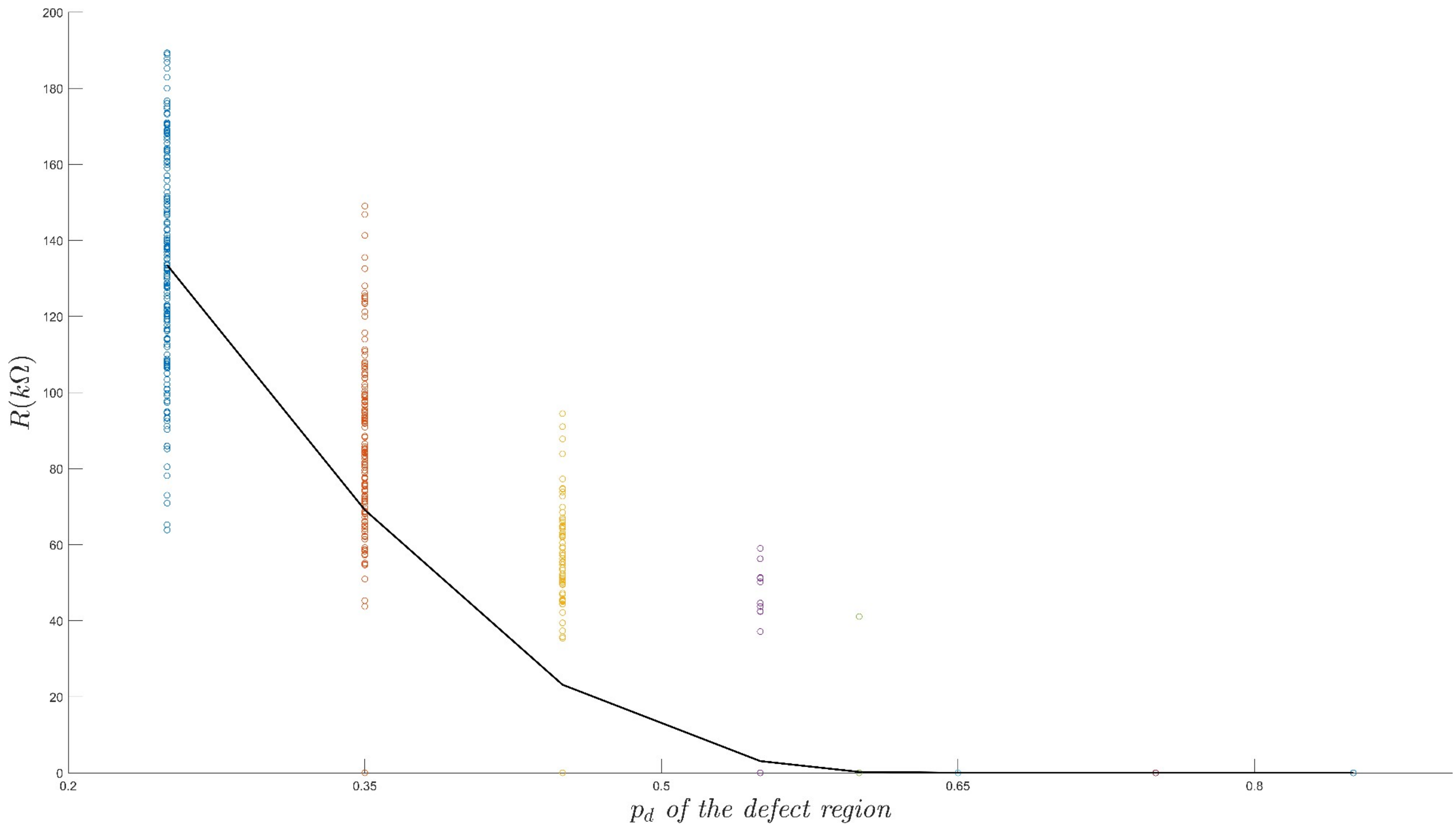

Figure S5. Electrical resistance *R* versus percolation probability *p* for 170 rectangular samples with defect regions (m = 40, n = 10). The markers indicate the resistance data while the solid line indicates the mean resistance.

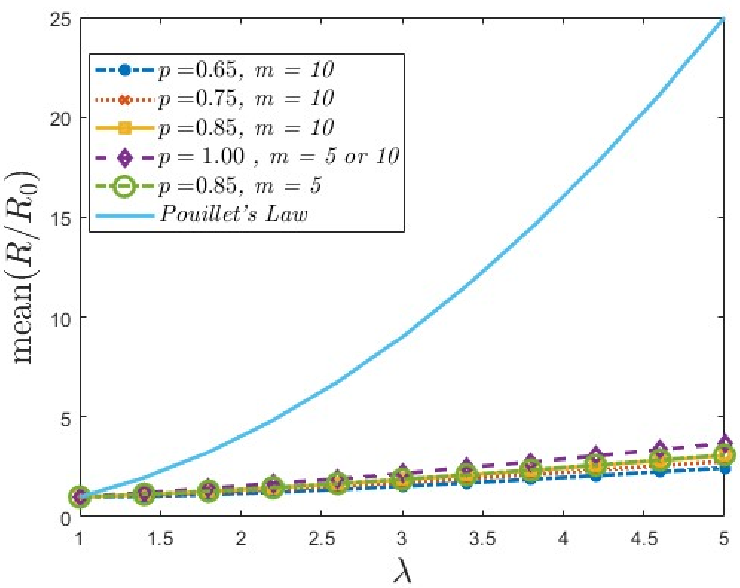

Figure S6. Normalized resistance versus stretch ratio for percolated square models with *m* = 5 and *m*=10. This figure corresponds to Figure 6d in the paper. The samples exhibit strain-insensitive resistance compared to the Pouillet's law.

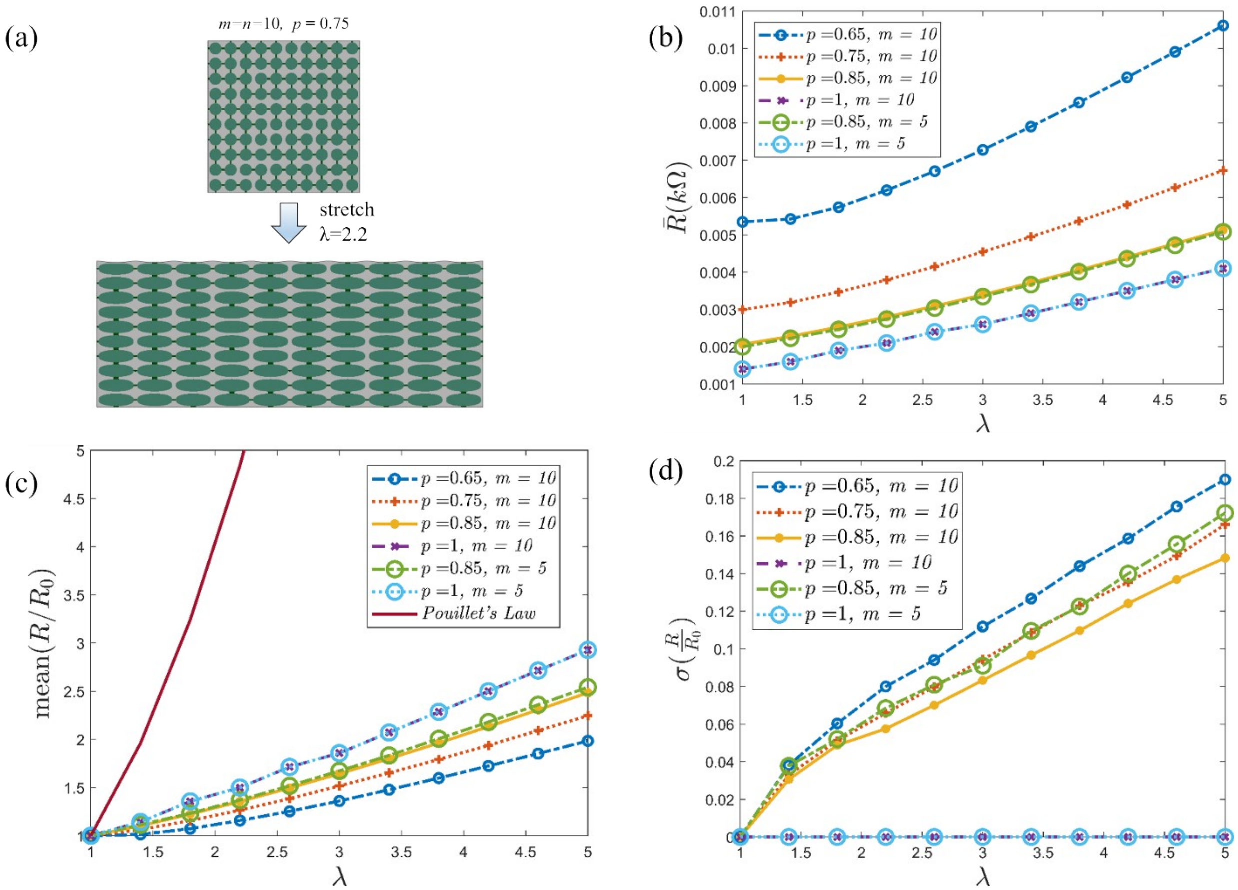

Figure S7 Electromechanical responses of the LMPCs including 50 vol% of LM. The results are similar to Figure 6. (a) A square sample with 10*10 unit cells before and after stretch. The unit cell is 10 μm and the particle diameter is 7.98 μm. The percolation probability is p = 0.75. (b) Influence of the stretch ratio λ on the mean resistance. (c) Influence of the stretch ratio λ on the normalized resistance. The finite-size effect has no correlation with the stretch-resistance responses. (d) Influence of the stretch ratio λ on the standard deviation of the normalized resistance. A smaller sample size induces greater variance of the normalized resistance. Each data point is averaged from 50 simulation models.