

Hierarchical self-assembly of desiccation crack patterns in clay induced by a uniform electric field

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Crack patterns formed by desiccation in clay are known to give rise to characteristic patterns [1, 2]. The patterns are affected by various factors, such as the drying material, the substrate and ambient conditions like temperature and relative humidity. External conditions like electric fields and magnetic fields also control details of the crack patterns.

Cylindrically symmetric static DC (i.e. Direct Current) electric fields [3] and AC (Alternating Current) fields [4] can be used to tailor the crack patterns in specific geometrical arrangements. Here we describe another experiment.

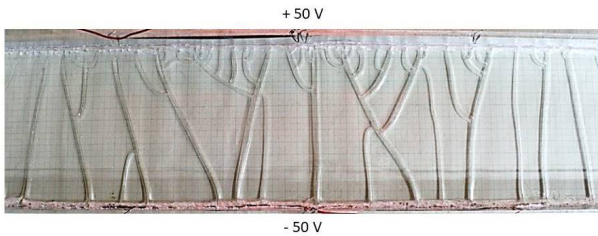


FIG. 1. The longer sides of the rectangular perspex box are fitted with metal foils, acting as positive (upper end in figure) and negative electrodes (lower end in figure). A DC voltage of 50 V is applied across the width of the sample.

We applied a *uniform* static electric field to an aqueous layer of clay suspension while drying. This caused a self-assembly of the cracks into an interesting pattern, dictated by the energy supplied to the system.

Initially closely spaced straight cracks appear at the positive electrode. As the sample dries these cracks merge together in small groups. Several stages of this merging produces the final hierarchical pattern.

The final pattern is distinctly tree-like, or river like, consisting of hierarchical structures as shown in Fig. 1. River like crack structures have been observed and discussed previously [5], but not in dried clay pastes as we observe here. We try to analyse the patterns and explain their origin. The redistribution of mobile ions in the aqueous clay slurry is assumed to be responsible for the pattern formation. The process may be useful in producing tailored crack patterns for applications in nano-patterning.

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