

SOLVENT VAPOR SORPTION IN THIN PMMA FILMS

Allan L. Smith and Fletcher C. Smith

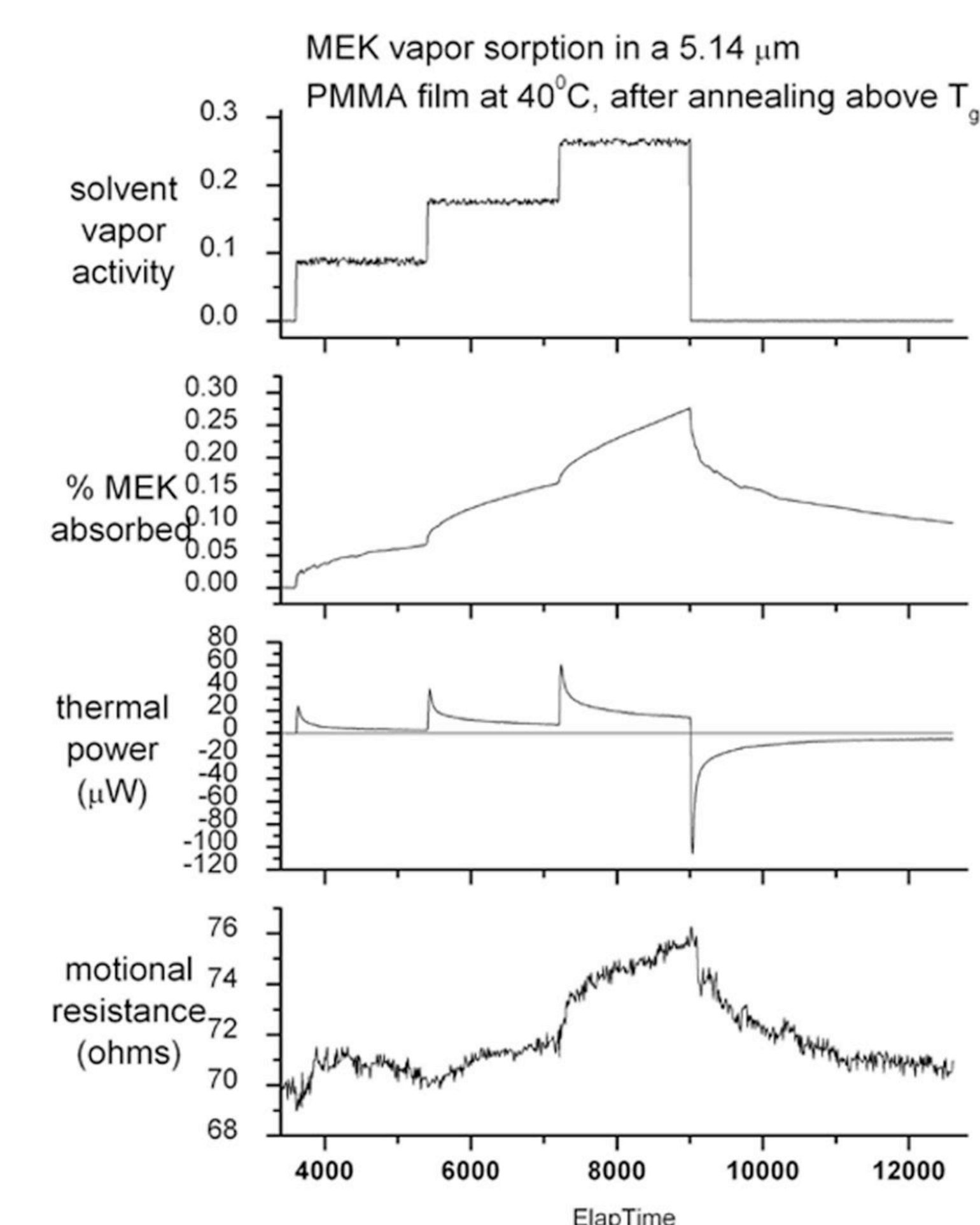
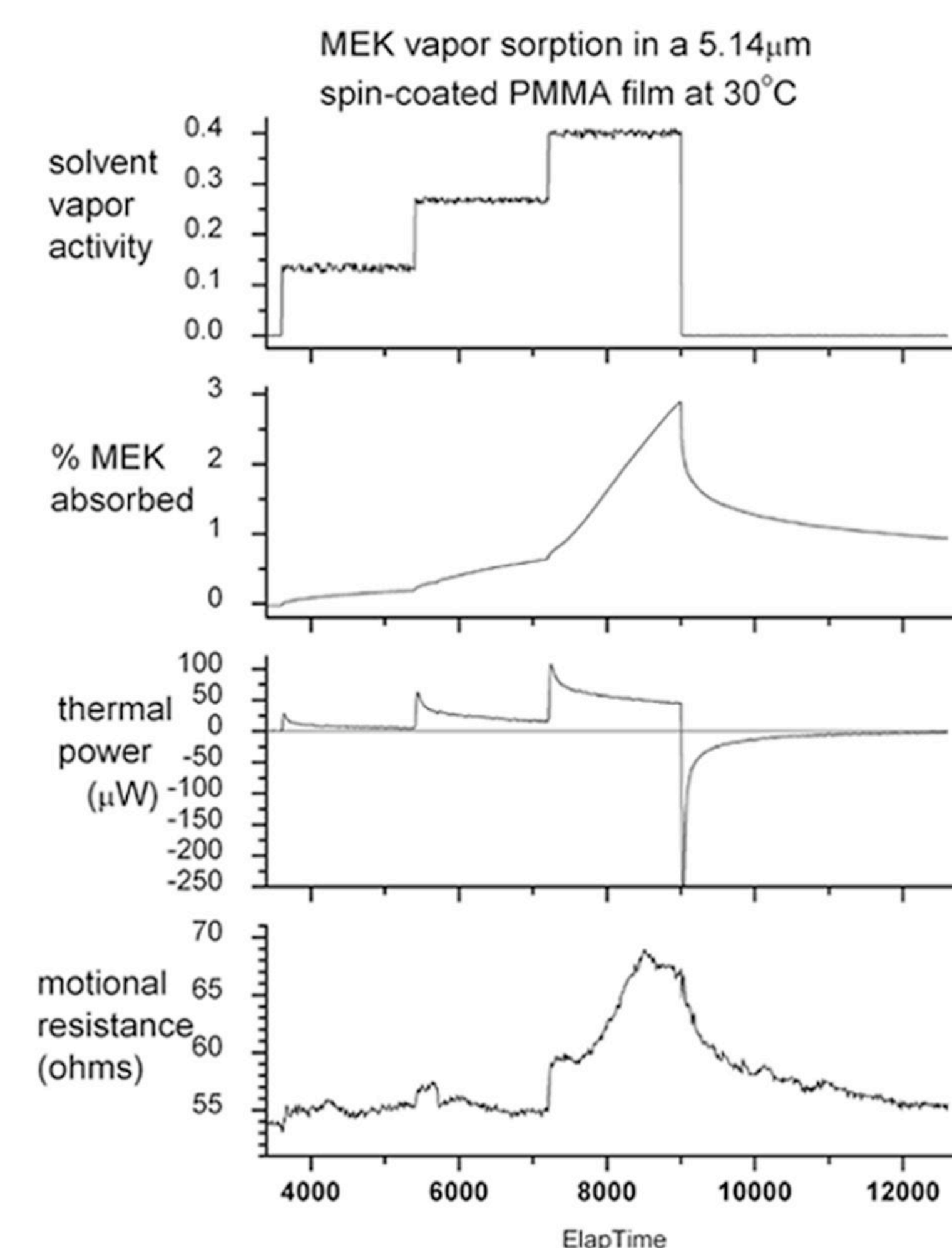
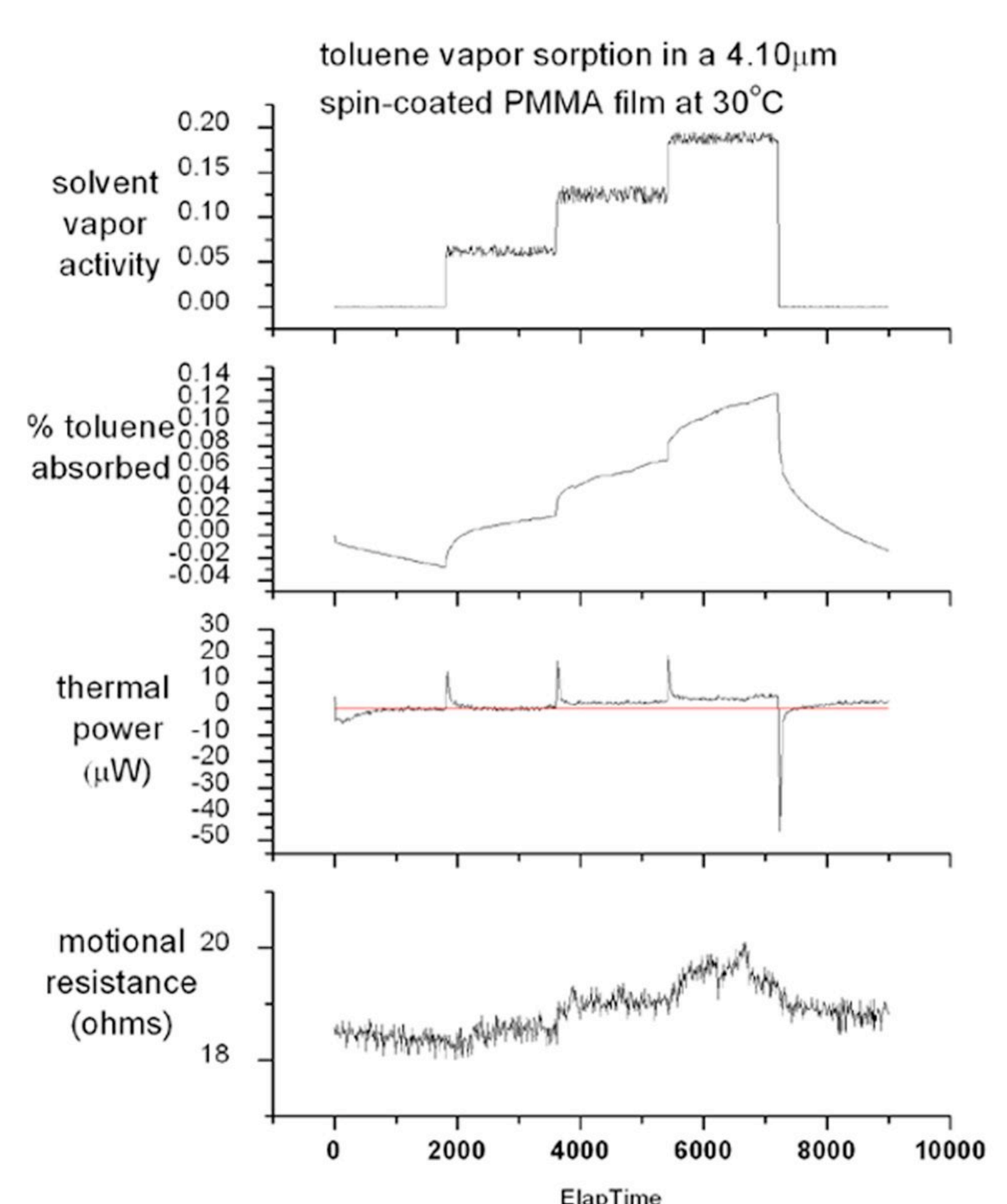
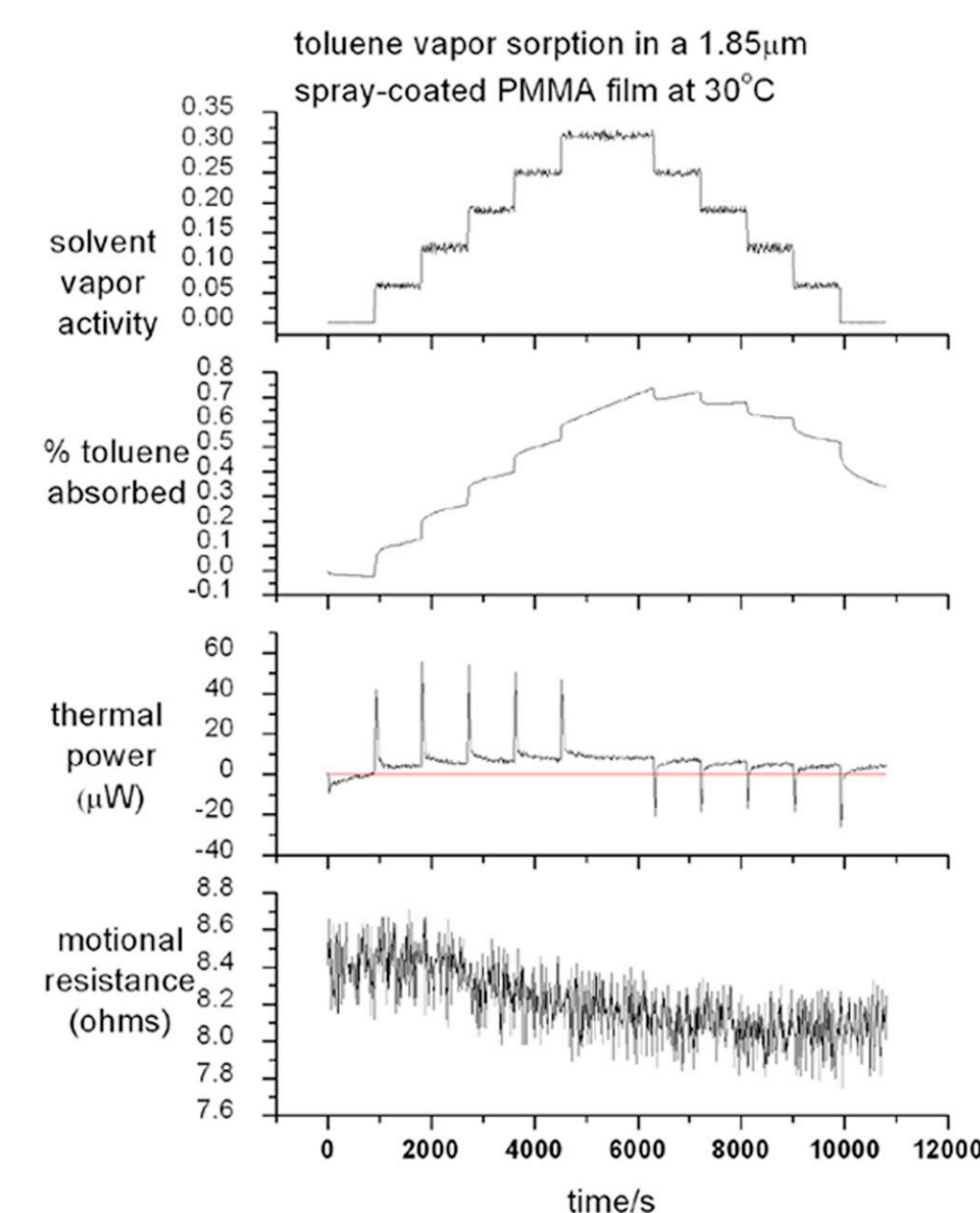
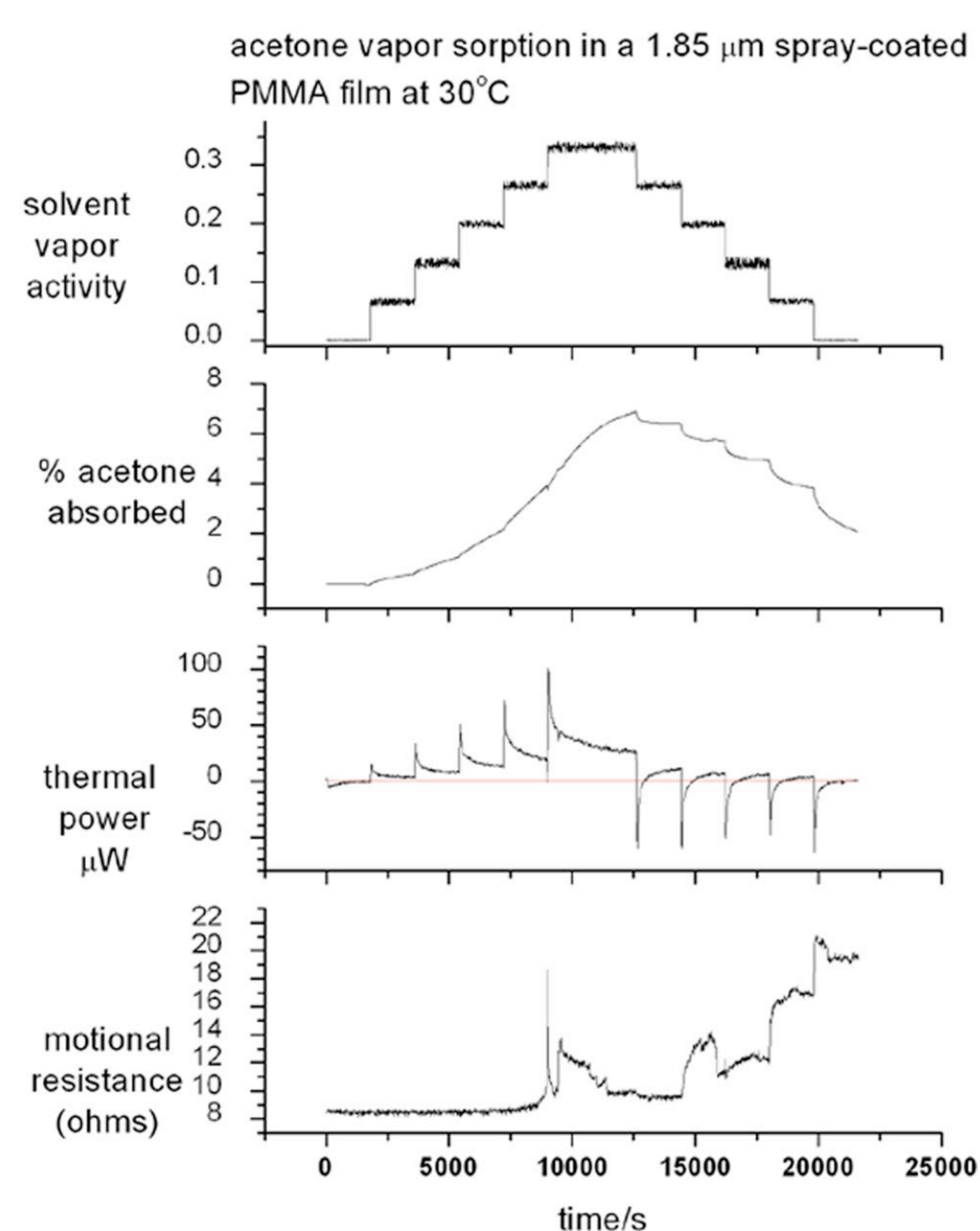
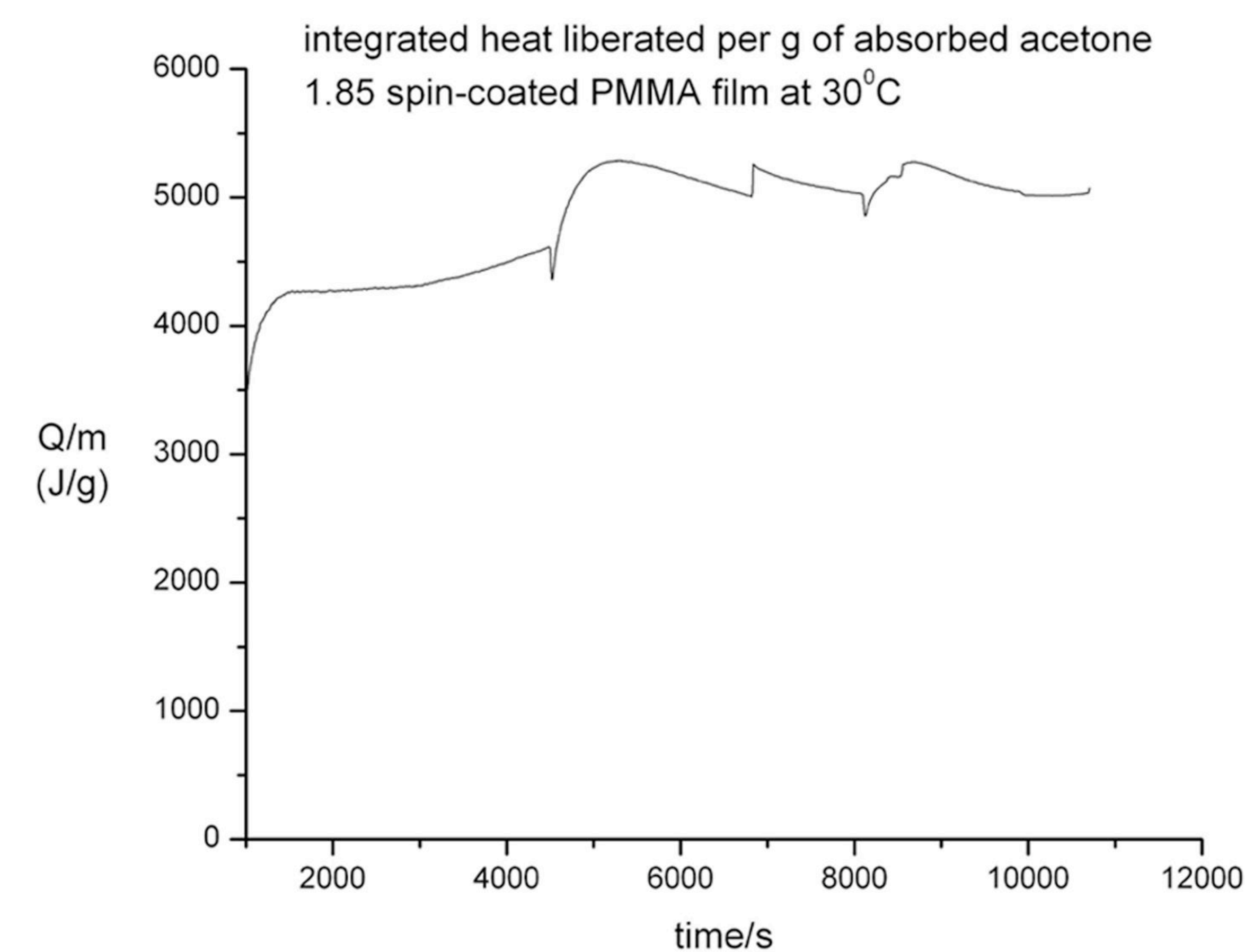
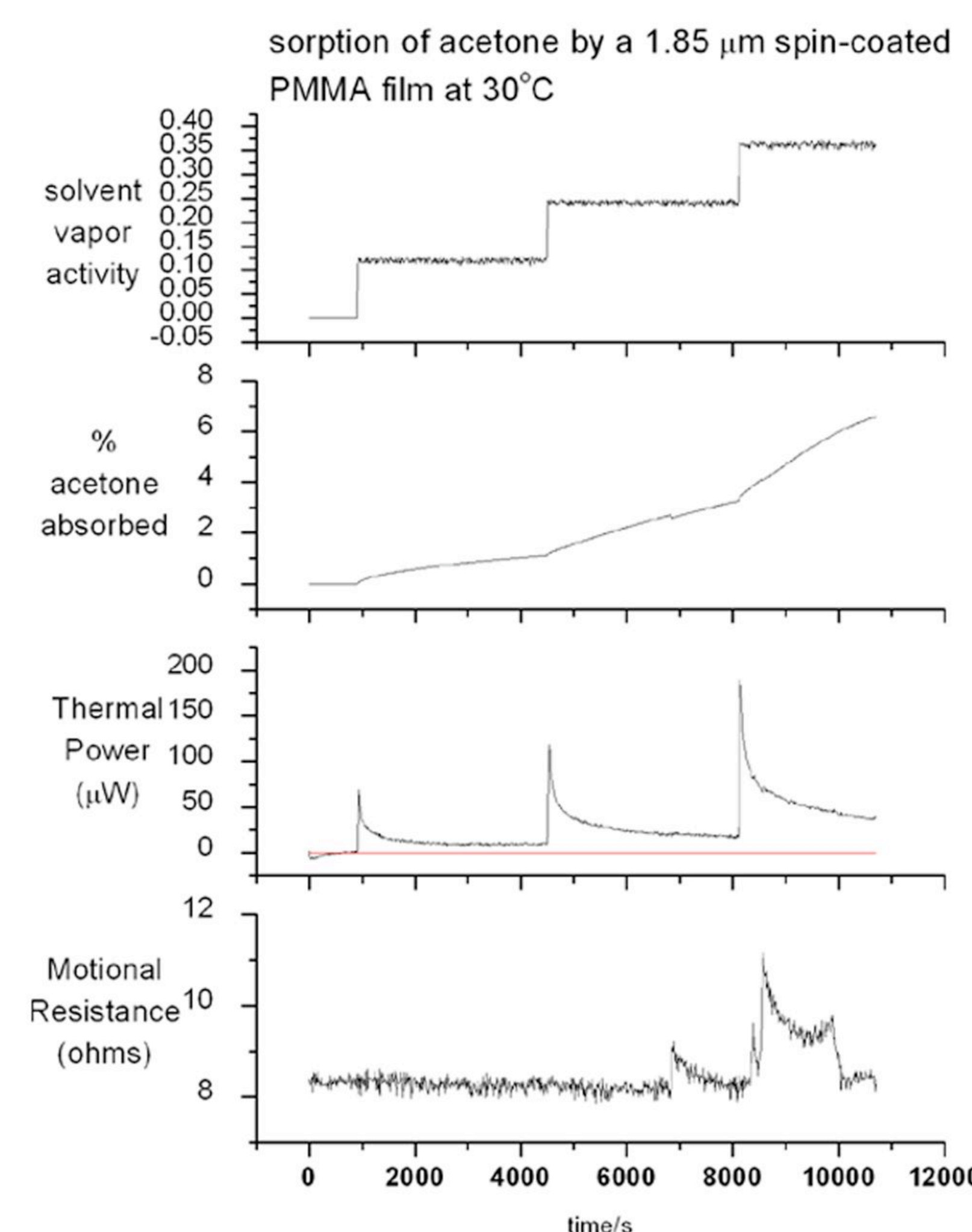
Abstract:

Acrylic polymers such as poly(methylmethacrylate) (PMMA) are used as coatings binders. Thermoplastic films prepared at ambient temperature by drying a PMMA solution form hard, resistant finishes widely used in architectural and automotive coatings. Cast forms of PMMA can be shaped into glazing materials and biomedical or optical components. Many properties of this industrially important polymer differ widely below and above the glass transition temperature, $T_g = 105^\circ\text{C}$.

We have utilized the Masscal G1 solvent vapor sorption analyzer (see www.masscal.com) to observe the sorption of three solvent vapors – acetone, methylethyl ketone (2-butanone), and toluene – in thin films of PMMA (1 to 5 μm) produced by spray-coating and spin-coating. All experiments were performed isothermally, with solvent vapor activity varied in steps by means of a dual mass flow controller subsystem external to the nanobalance/calorimeter. Temperatures varied from 30°C to 70°C .

Conclusions

- Organic solvent vapor absorption occurs very slowly in PMMA for all three solvents, and equilibrium is not reached after several hours even in the thinnest films. However, the ratio of integrated heat to absorbed mass is roughly constant, a measure of the enthalpy of sorption of the solvent in PMMA. No other measurements of the enthalpy of solution of these solvents in PMMA exist.
- Damping of the QCM mass sensor by the PMMA film (measured by increasing motional resistance) shows abrupt changes with increasing solvent vapor activity. The plasticization of PMMA by organic solvents is a complex process.
- Annealing a spray-coated PMMA film above T_g for 10 minutes decreased the sorption of toluene by a factor of four and of MEK by a factor of ten.



All measurements obtained with
Masscal Solvent Vapor Sorption Analyzer