Thermal Contraction Guided Cryoprotection Optimization for Macromolecular Cryocrystallography

Douglas Juers
Department of Physics & Program in Biochemistry, Biophysics & Molecular Biology, Whitman College, Walla Walla WA
juersdh@whitman.edu

Selection of cryoprotective agents for macromolecular crystallography is currently based mainly on trial and error. Here we investigate the notion of using thermal contraction as a guide for cryoprotection optimization. Testing several different crystals we find the contraction of the unit cell with cooling is linear with cryosolvent contraction over most of the contraction range tested. The effect is more significant for crystals with larger pores, and for these crystals there is a relatively broad optimum (~2-8%) in the crysolvent contraction that minimizes the low temperature mosaicity. Larger and smaller contractions are deleterious to crystal order. Curiously, in some cases ice formation is correlated with greater cell contraction, suggesting flow of solvent into collection regions within the crystal during cooling, increasing crystal disorder. Experiments on the effects of cryosolvent contraction on the thermal response of both the crystal and the macromolecule will be discussed as well as how the results point towards more rational cryoprotection strategies.

References

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