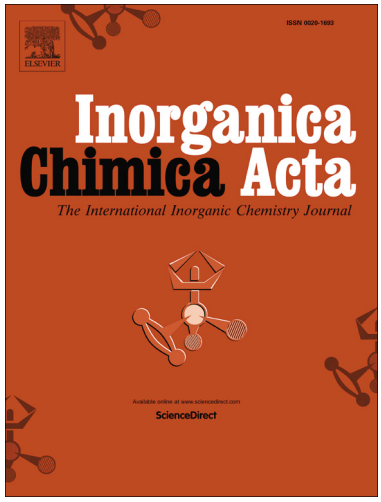

Research paper

Mechanochemical synthesis of zinc and palladium complexes of dialkyl 2,2′-bipyridine-4,4′-dicarboxylate and analysis of solid-state reaction kinetics

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PII: S0020-1693(17)31879-0
DOI: https://doi.org/10.1016/j.ica.2018.03.004
Reference: ICA 18149

To appear in: *Inorganica Chimica Acta*

Received Date: 15 December 2017
Revised Date: 5 March 2018
Accepted Date: 6 March 2018

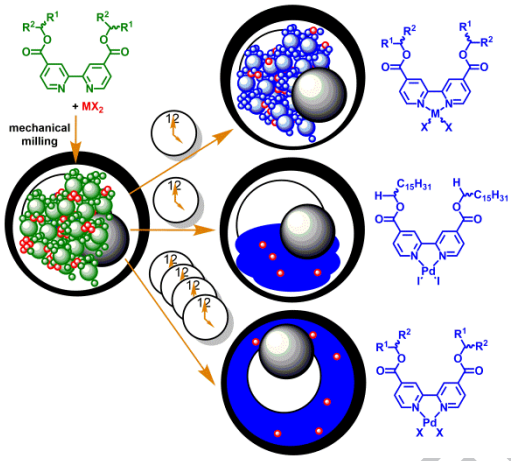
Please cite this article as: R.J. Allenbaugh, J.R. Zachary, J.R. Williams, A.L. Shaw, J.D. Bryson, A. Nicole Underwood, E.E. O'Donnell, Mechanochemical synthesis of zinc and palladium complexes of dialkyl 2,2′-bipyridine-4,4′-dicarboxylate and analysis of solid-state reaction kinetics, *Inorganica Chimica Acta* (2018), doi: https://doi.org/10.1016/j.ica.2018.03.004

Mechanochemical synthesis of zinc and palladium complexes of dialkyl 2,2′-bipyridine-4,4′-dicarboxylate and analysis of solid-state reaction kinetics.

Rachel J. Allenbaugh[#], Jonathon R. Zachary, Joseph R. Williams, Angela L. Shaw, Jeffrey D. Bryson, A. Nicole Underwood, and Erin E. O'Donnell

Department of Chemistry, Murray State University, 1201 Jesse D. Jones Hall, Murray, KY 42071.

[#]Author to whom correspondence should be addressed: rallenbaugh@murraystate.edu.



Mechanochemical synthesis of a series of Zn and Pd dialkyl 2,2′-bipyridine-4,4′-dicarboxylate complexes (L^n, where n specifies the number of carbons in the α- or β-substituted alkyl chains) including $ZnL^{\beta12}Cl_2$, $ZnL^{\beta14}Cl_2$, $ZnL^{\alpha14}Cl_2$, $ZnL^{\alpha14}I_2$, and $PdL^{\alpha14}Cl_2$ is explored through a variety of linear and sigmoidial reaction models. The Johnson-Mehl-Avrami-Yerofeev-Kolmogrov (JMAYK) and Finke-Watzky (FW) models are largely equivalent as demonstrated through analysis of Akaike weights. This analysis was extended to the previously reported syntheses of $PdL^{\beta10}I_2$, $PdL^{\alpha16}I_2$, and $PdL^{\beta16}I_2$ with similar results, except that the JMAYK model is significantly superior to the FW model for $PdL^{\beta16}I_2$. The physical properties of the reaction mixture, most prominently whether the product phase is easily mixed, is a major factor in determining the rate of reaction.

Keywords: mechanochemistry; ball mill; solid-state synthesis; kinetics; transition metal complexes

1. Introduction

Mechanochemical synthesis, although not a new technology, is currently being used to prepare many more types of compounds than the oxides, alloys, and compounds that were the previously the focus of the technique [1, 2]. Sustainability drives much of this research as the mechanical force used in these syntheses can be applied in the absence of solvent, drastically reducing the waste in these reactions [3]. From the perspective of researchers at less well-resourced institutions, mechanochemistry also provides a method for highly cost-effective preparation of transition metal complexes; an area of study only recently emerged in mechanochemical synthesis [4]. However, in order for mechanochemical synthesis to be utilized for routine small molecule and