

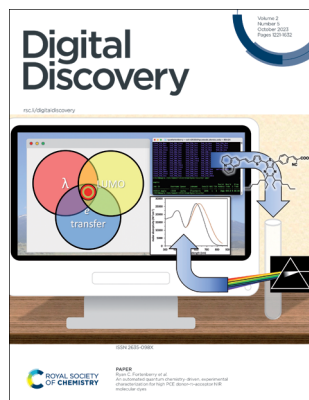
# Digital Discovery

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## IN THIS ISSUE

ISSN 2635-098X CODEN DDIIAI 2(5) 1221–1632 (2023)



### Cover

See Ryan C. Fortenberry et al., pp. 1269–1288.  
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### Inside cover

See Jean-Louis Reymond et al., pp. 1289–1296. Image reproduced by permission of Markus Orsi from *Digital Discovery*, 2023, 2, 1289.  
Background: David Teniers the Younger, "The Alchemist". Mauritshuis, The Hague.

## PERSPECTIVES

1233

### 14 examples of how LLMs can transform materials science and chemistry: a reflection on a large language model hackathon

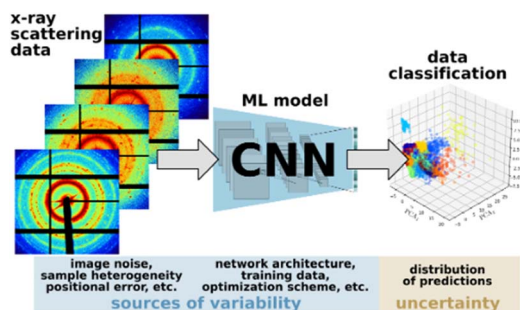
K. M. Jablonka,\* Q. Ai, A. Al-Feghali, S. Badhwar, J. D. Bocarsly, A. M. Bran, S. Bringuier, L. C. Brinson, K. Choudhary, D. Circi, S. Cox, W. A. de Jong, M. L. Evans, N. Gastellu, J. Genzling, M. V. Gil, A. K. Gupta, Z. Hong, A. Imran, S. Kruschwitz, A. Labarre, J. Lala, T. Liu, S. Ma, S. Majumdar, G. W. Merz, N. Moitessier, E. Moubarak, B. Mouriño, B. Pelkie, M. Pieler, M. Ramos, B. Ranković, S. G. Rodrigues, J. N. Sanders, P. Schwaller, M. Schwarting, J. Shi, B. Smit, B. E. Smith, J. Van Herck, C. Völker, L. Ward, S. Warren, B. Weiser, S. Zhang, X. Zhang, G. A. Zia, A. Scourtas, K. J. Schmidt, I. Foster, A. D. White and B. Blaiszik\*



1251

### A rigorous uncertainty-aware quantification framework is essential for reproducible and replicable machine learning workflows

Line Pouchard, Kristofer G. Reyes, Francis J. Alexander and Byung-Jun Yoon\*



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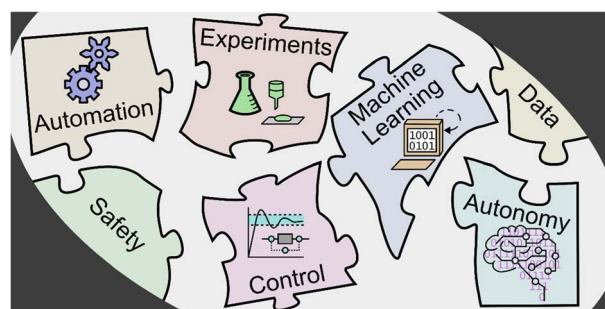


## PERSPECTIVES

1259

## Integrating autonomy into automated research platforms

Richard B. Canty, Brent A. Koscher, Matthew A. McDonald and Klavs F. Jensen\*

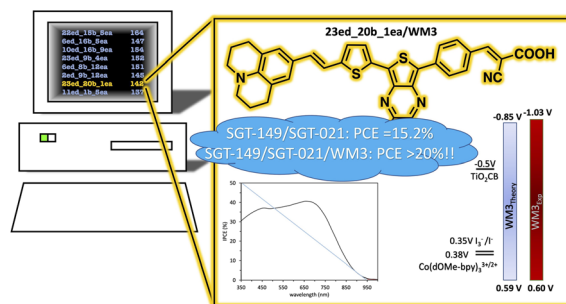


## PAPERS

1269

An automated quantum chemistry-driven, experimental characterization for high PCE donor- $\pi$ -acceptor NIR molecular dyes

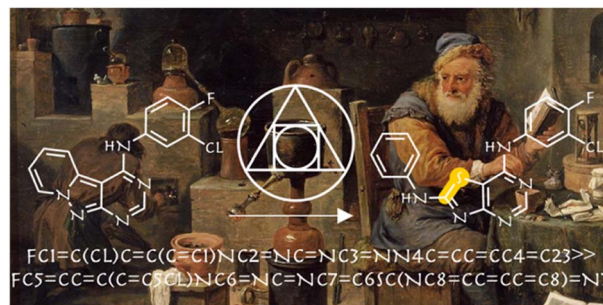
Taylor J. Santaloci, William E. Meador, Austin M. Wallace, E. Michael Valencia, Blake N. Rogers, Jared H. Delcamp and Ryan C. Fortenberry\*



1289

## Alchemical analysis of FDA approved drugs

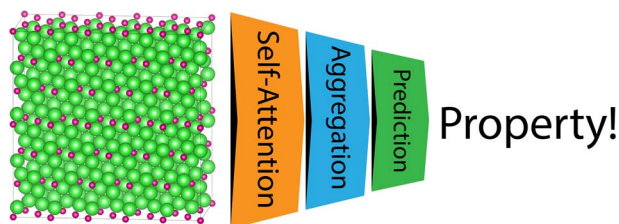
Markus Orsi, Daniel Probst, Philippe Schwaller and Jean-Louis Reymond\*



1297

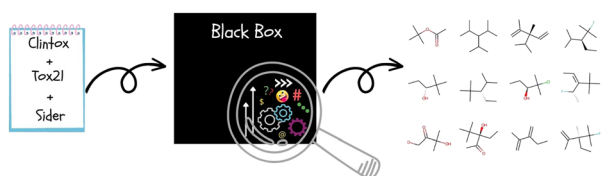
## Site-Net: using global self-attention and real-space supercells to capture long-range interactions in crystal structures

Michael Moran, Michael W. Gaultois,\* Vladimir V. Gusev and Matthew J. Rosseinsky



## PAPERS

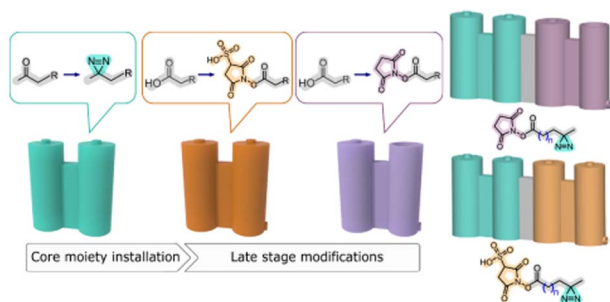
1311



### Generating structural alerts from toxicology datasets using the local interpretable model-agnostic explanations method

Cayque Monteiro Castro Nascimento, Paloma Guimarães Moura and Andre Silva Pimentel\*

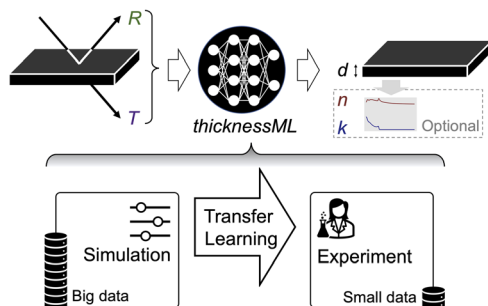
1326



### Digital design and 3D printing of reactionware for on demand synthesis of high value probes

Przemyslaw Frei, Philip J. Kitson, Alexander X. Jones and Leroy Cronin\*

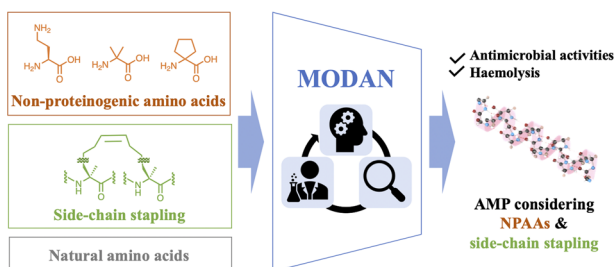
1334



### Tackling data scarcity with transfer learning: a case study of thickness characterization from optical spectra of perovskite thin films

Siyu Isaac Parker Tian, Zekun Ren, Selvaraj Venkataraj, Yuanhang Cheng, Daniil Bash, Felipe Oviedo, J. Senthilnath, Vijila Chellappan, Yee-Fun Lim, Armin G. Aberle, Benjamin P. MacLeod, Fraser G. L. Parlane, Curtis P. Berlinguette, Qianxiao Li, Tonio Buonassisi\* and Zhe Liu

1347



### Design of antimicrobial peptides containing non-proteinogenic amino acids using multi-objective Bayesian optimisation

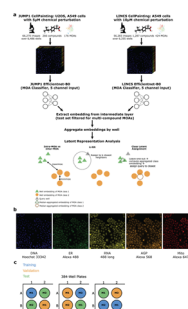
Yuki Murakami, Shoichi Ishida, Yosuke Demizu and Kei Terayama\*



## PAPERS

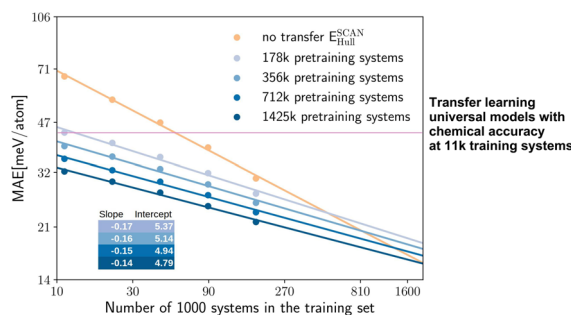
1354

## Deep representation learning determines drug mechanism of action from cell painting images

Daniel R. Wong,<sup>\*</sup> David J. Logan, Santosh Hariharan, Robert Stanton, Djork-Arné Clevert and Andrew Kiruluta

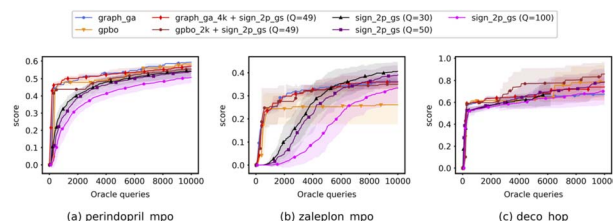
1368

## Transfer learning on large datasets for the accurate prediction of material properties

Noah Hoffmann, Jonathan Schmidt, Silvana Botti and Miguel A. L. Marques<sup>\*</sup>

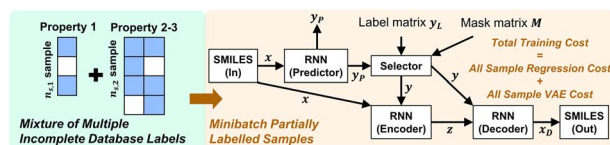
1380

## Understanding and improving zeroth-order optimization methods on AI-driven molecule optimization

Elvin Lo and Pin-Yu Chen<sup>\*</sup>

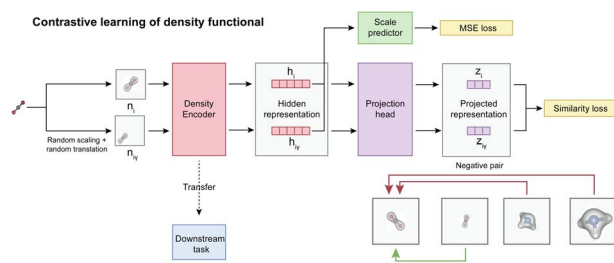
1390

## Multi-constraint molecular generation using sparsely labelled training data for localized high-concentration electrolyte diluent screening

Jonathan P. Mailoa,<sup>\*</sup> Xin Li, Jiezhong Qiu and Shengyu Zhang<sup>\*</sup>



1404

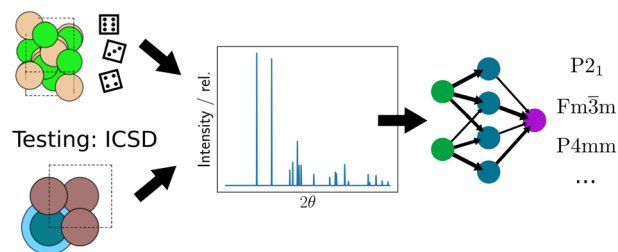


### Incorporation of density scaling constraint in density functional design via contrastive representation learning

Weiye Gong, Tao Sun, Hexin Bai, Shah Tanvir ur Rahman Chowdhury, Peng Chu, Anoj Aryal, Jie Yu, Haibin Ling,\* John P. Perdew\* and Qimin Yan\*

1414

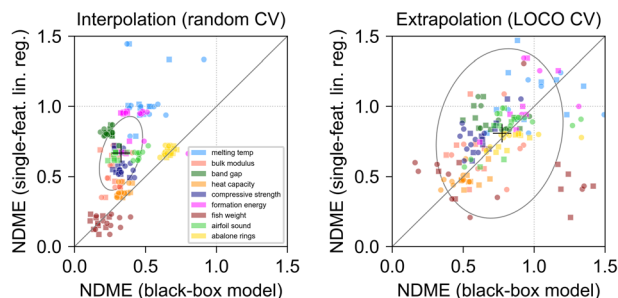
Training: Synthetic



### Neural networks trained on synthetically generated crystals can extract structural information from ICSD powder X-ray diffractograms

Henrik Schopmans, Patrick Reiser and Pascal Friederich\*

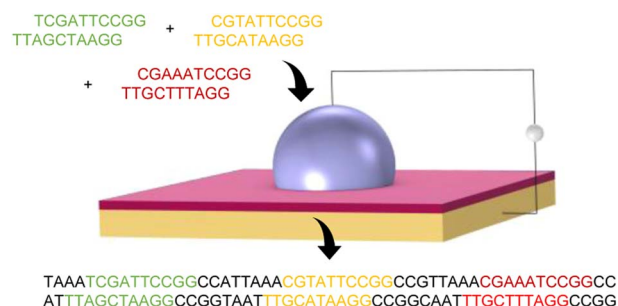
1425



### Interpretable models for extrapolation in scientific machine learning

Eric S. Muckley, James E. Saal,\* Bryce Meredig, Christopher S. Roper and John H. Martin

1436



### Automated routing of droplets for DNA storage on a digital microfluidics platform

Ajay Manicka, Andrew Stephan, Sriram Chari, Gemma Mendonsa, Peyton Okubo, John Stolzberg-Schray, Anil Reddy and Marc Riedel

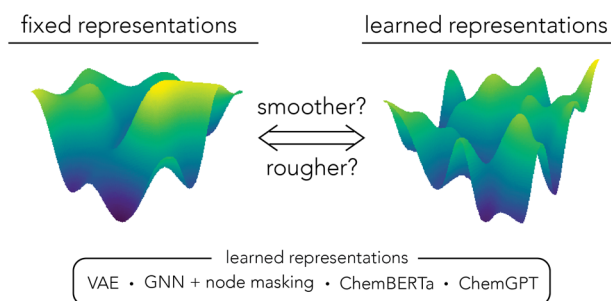


## PAPERS

1452

### Evaluating the roughness of structure–property relationships using pretrained molecular representations

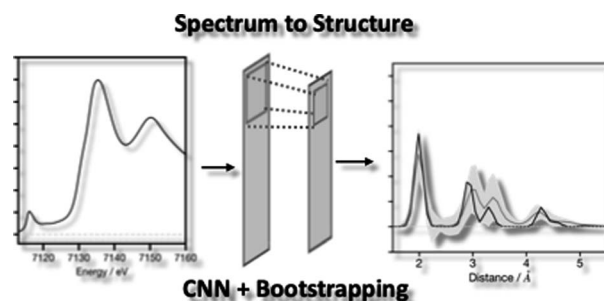
David E. Graff, Edward O. Pyzer-Knapp, Kirk E. Jordan, Eugene I. Shakhnovich and Connor W. Coley



1461

### Towards the automated extraction of structural information from X-ray absorption spectra

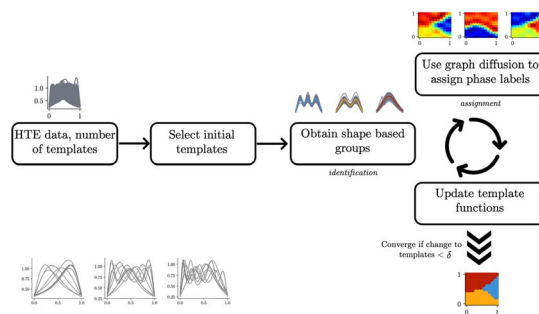
Tudur David,\* Nik Khadijah Nik Aznan, Kathryn Garside and Thomas Penfold



1471

### Metric geometry tools for automatic structure phase map generation

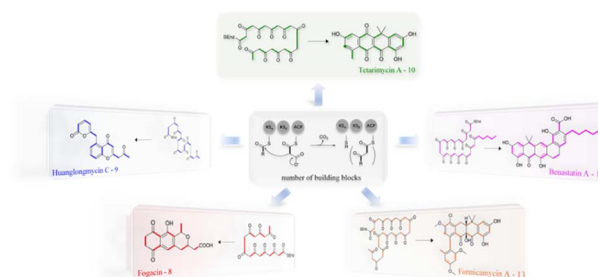
Kiran Vaddi,\* Karen Li and Lilo D. Pozzo



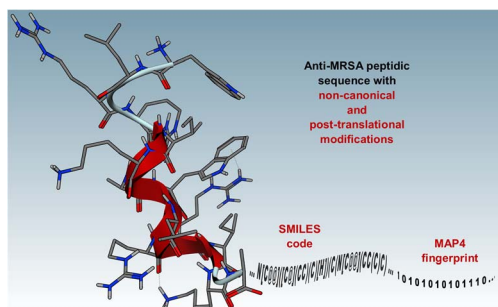
1484

### A deep learning model for type II polyketide natural product prediction without sequence alignment

Jiaquan Huang, Qiandi Gao, Ying Tang, Yaxin Wu, Heqian Zhang\* and Zhiwei Qin\*



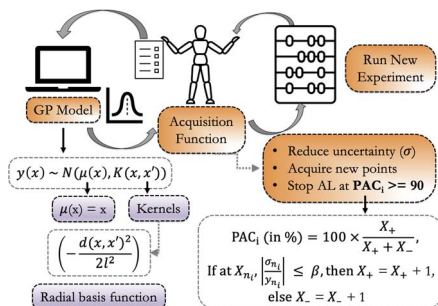
1494



## Mapping the structure–activity landscape of non-canonical peptides with MAP4 fingerprinting

Edgar López-López,<sup>\*</sup> Oscar Robles, Fabien Plisson and José L. Medina-Franco<sup>\*</sup>

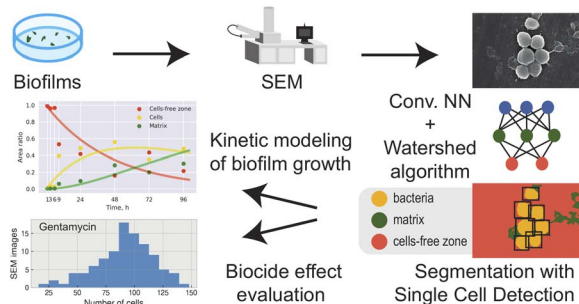
1506



## Active learning for efficient navigation of multi-component gas adsorption landscapes in a MOF

Krishnendu Mukherjee, Etinosa Osaro and Yamil J. Colón<sup>\*</sup>

1522



## Digital biology approach for macro-scale studies of biofilm growth and biocide effects with electron microscopy

Konstantin S. Kozlov, Daniil A. Boiko, Elena V. Detusheva, Konstantin V. Detushev, Evgeniy O. Pentsak, Anatoly N. Vereshchagin and Valentine P. Ananikov<sup>\*</sup>

1540



## Go with the flow: deep learning methods for autonomous viscosity estimations

Michael Walker, Gabriella Pizzuto, Hatem Fakhruldeen and Andrew I. Cooper<sup>\*</sup>





## Using GPT-4 in parameter selection of polymer informatics: improving predictive accuracy amidst data scarcity and 'Ugly Duckling' dilemma

The diagram consists of three concentric ellipses. The outermost ellipse is green and labeled "All descriptors". The middle ellipse is teal and labeled "GPT-4 oriented". The innermost ellipse is yellow and labeled "Data-oriented". To the right of these ellipses is a vertical arrow pointing downwards, labeled "Selection".

## Element similarity in high-dimensional materials representations

# Chemical Elements as Vectors

One hot encoding	$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \dots \end{bmatrix}$ H
Distributed embedding	$\begin{bmatrix} 1 & 1 & 0 & 1 & 0 & 0 & 1 & 0 & 0 \dots \end{bmatrix}$ From machine learning

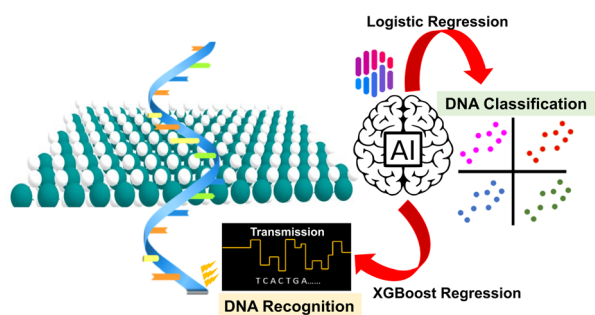
# Density functional theory and machine learning for electrochemical square-scheme prediction: an application to quinone-type molecules relevant to redox flow batteries

# Combined data-driven and mechanism-based approaches for human-intestinal-absorption prediction in the early drug-discovery stage

The diagram illustrates two contrasting approaches to drug discovery, centered around a brain icon on a desk with a laptop and books.

- Data-driven Approach (Left):** This approach is represented by a large stack of papers. Two callouts show specific chemical structures: one labeled 'Fa: 5%' and another labeled 'Fa: 99%'. Arrows point from these structures to the stack of papers, indicating that a large volume of data is used to identify potential leads.
- Mechanism-based Approach (Right):** This approach is represented by a glass of water and a red, textured shape labeled 'Pn'. A callout shows a chemical structure labeled 'Do' and 'On' with arrows pointing to the 'Pn' shape, suggesting a focus on understanding the underlying mechanism of action.

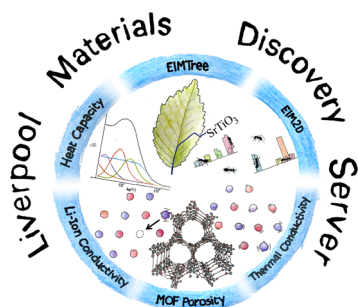
1589



### Artificial intelligence aided recognition and classification of DNA nucleotides using MoS<sub>2</sub> nanochannels

Sneha Mittal, Souvik Manna, Milan Kumar Jena and Biswarup Pathak\*

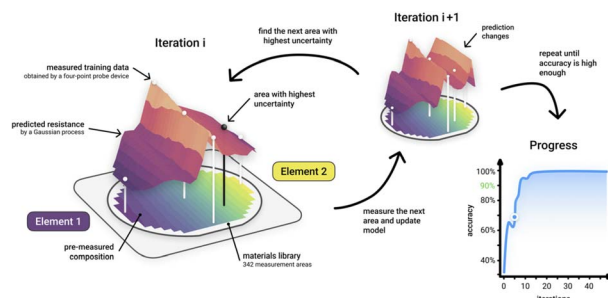
1601



### The Liverpool materials discovery server: a suite of computational tools for the collaborative discovery of materials

Samantha Durdy, Cameron J. Hargreaves, Mark Dennison, Benjamin Wagg, Michael Moran, Jon A. Newnham, Michael W. Gaultois, Matthew J. Rosseinsky and Matthew S. Dyer\*

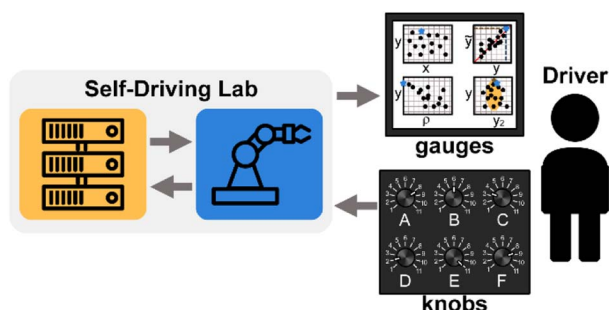
1612



### Speeding up high-throughput characterization of materials libraries by active learning: autonomous electrical resistance measurements

Felix Thelen, Lars Banko, Rico Zehl, Sabrina Baha and Alfred Ludwig\*

1620



### Driving school for self-driving labs

Kelsey L. Snapp and Keith A. Brown\*

