

PHYSICS

Kepler's third law of three-body and n -body systems under the Newtonian gravitation field

Newton's gravitational law and Kepler's laws derived therefrom are the first triumph of science that confirms a purely human invention of mathematics, and are able to describe observations in nature. Numerical breakthroughs on three-body orbits have led to a conjecture that the three-body system may obey Kepler's law of 'harmonies'. Recently, **Bohua Sun** from the Cape Peninsula University of Technology in South Africa proposed a relation for the law from the perspective of dimensional analysis and the mass-product symmetry constraint of Newton's gravitational law: $T_n |E_n|^{3/2} = \frac{\pi}{\sqrt{2}} G \left[\frac{\sum_{i=1}^n \sum_{j=i+1}^n (m_i m_j)^3}{\sum_{k=1}^n m_k} \right]^{1/2}$, which would provide a helpful guide in the search for a new periodic orbit of a celestial planetary system.

[Sun BH. *Sci China-Phys Mech Astron* 2018; **61**: 054721]

CHEMISTRY

Perylenediimide-based nanoparticles for efficient cancer photothermal therapy

Photothermal therapy is an advanced and non-invasive treatment. However, conventional organic photothermal agents are unstable under irradiation. Recently, Meizhen Yin's group from Beijing University of Chemical Technology reported perylenediimide-based self-assembled nanoparticles (PDI-NPs) as photothermal agents. The photothermal

agents have excellent photostability and photothermal conversion for cancer therapy *in vivo*. Their work opens a new possibility for developing efficient photothermal agents.

[Zhang S *et al. Sci Bull* 2018; **63**: 101–7]

CHEMISTRY

Single-component iron catalysis for aerobic oxidation of aldehydes to carboxylic acids

Traditional oxidation methods to produce acids usually require stoichiometric amounts of strong and toxic oxidants, which cause a severe environmental burden. Recently, Shengming Ma (Shanghai Institute of Organic Chemistry, CAS) and co-workers reported an efficient oxidation reaction to obtain carboxylic acids from aldehydes at room temperature using O_2 or O_2 in air as the oxidant with $Fe(NO_3)_3 \cdot 9H_2O$ as the single-component catalyst. Two plausible pathways were proposed after careful mechanistic studies. Several 50-mmol-scale reactions were conducted to demonstrate the practicality of the method (see Fig. 1).

[Jiang X *et al. Chin J Chem* 2018; **36**: 15–9]

CHEMISTRY

Light drives organic reactions

Transition-metal-catalyzed C–H functionalization of olefins under mild conditions has attracted great interest, yet is still challenging. Light as the green tool in organic synthesis can significantly affect the reaction. Yao Fu, Zhenhua Gu and co-workers at the University of Science and Technology of China reported a visible-light-promoted palladium-catalyzed C–H arylation, where, for the first time, the researchers observed the changes of the kinetic isotope effect: from 3.6 (in darkness) to 1.1 (under visible-light irradiation).

[Feng J *et al. Chin J Chem* 2018; **36**: 11–4]

CLINICAL MEDICINE

Seven CVH metrics and cardiovascular disease prevention

In Chinese general populations, it is unclear how large cardiovascular health (CVH) gains from achieving seven ideal CVH metrics, including four health behaviors (not smoking, ideal body mass

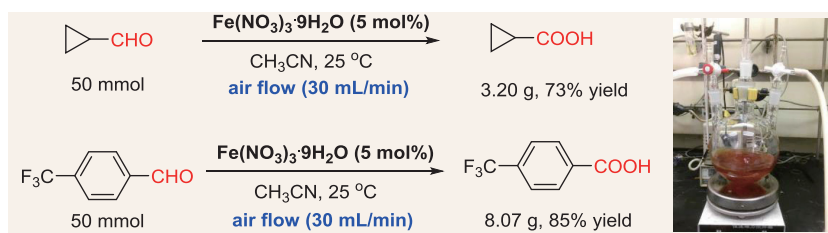


Figure 1. Some 50-mmol-scale reactions for iron-catalyzed aerobic oxidation of aldehydes.

index, regular physical activity, healthy diet) and three health factors (optimal profile of serum total cholesterol, blood pressure, and blood glucose). Using long-term cohorts among 93 987 Chinese adults, Dongfeng Gu from the National Center for Cardiovascular Disease, Fuwai Hospital, CAMS, revealed that 62.1% of atherosclerotic cardiovascular disease (ASCVD) was attributable to not achieving all the seven ideal CVH metrics. The more ideal CVH metrics that adults have, the smaller ASCVD burden there is in China. Maintaining the ideal blood pressure implied the largest public-health gains against various ASCVD events.

[Han C *et al. Sci China Life Sci* 2018; **61**: 504–14]

MOLECULAR BIOLOGY & GENETICS

MeCP2 deficiency promotes cell reprogramming

Methyl-CpG-binding protein 2 (MeCP2) connects DNA methylation and histone modification, which are key changes of somatic cell reprogramming. However, the role of MeCP2 in cell reprogramming has not been examined. Qi Zhou from the Institute of Zoology, CAS, and his colleagues reported that MeCP2 deficiency promoted cell reprogramming through stimulating IGF1/AKT/mTOR signaling and activating ribosomal protein-mediated cell cycle gene translation in the early stage of reprogramming (see Fig. 2). Their findings revealed the mechanism of MeCP2 in cell fate determination and provided a strategy to regulate

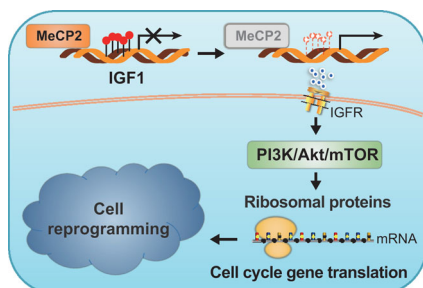


Figure 2. Proposed model of the role of MeCP2 deficiency in cell reprogramming.

cell reprogramming by modulating MeCP2.

[Zhang W *et al. J Mol Cell Biol* 2018; doi: 0.1093/jmcb/mjy018]

MOLECULAR BIOLOGY & GENETICS

An intronic DNA element functions as a silencer by recruiting an epigenetic repressor complex

Some non-coding DNA elements, such as silencers and enhancers, have important regulatory roles in gene expression regardless of their position and orientation. However, the underlying mechanisms are largely unknown. Recently, Letian Chen's group at the South China Agricultural University revealed that an intronic RY-element-containing *SE1* functions as a silencer of the rice gibberellin-deactivating gene *Eui1*, which recruits a repressor complex for histone deacetylation and H3K27me3, thereby generating a closed chromatin state in *Eui1*, and suppressing *Eui1* expression (see Fig. 3). These findings provide novel molecular insights into the regulatory network of gibberellin metabolism, and bring us closer to the general functions of intronic elements.

[Xie Y *et al. Mol Plant* 2018; **11**: 720–35]

GEOSCIENCES

Asian loess reached the Yangtze River by 0.9 Myr ago

The loess deposition near the Yangtze River is an important terrestrial paleoclimate archive in the low-latitude monsoon region. The timing of its occurrence is the key to understanding the cause of environmental change. Recently, the onset of loess deposition by 0.9 Ma was proposed by Xusheng Li (Nanjing University) and co-workers based on a magnetostratigraphic study. This finding reveals that significant aridification and winter monsoon strengthening occurred in this subtropical region in the late Early Pleistocene, which was primarily driven by global cooling and an in-

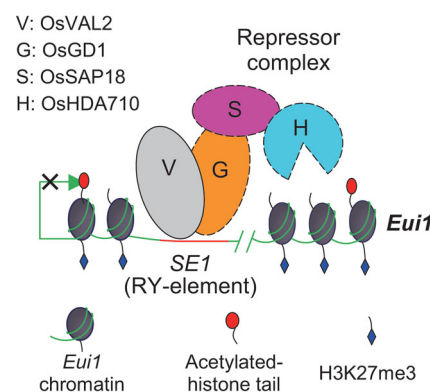


Figure 3. Working model for an *SE1*-mediated epigenetic repressor complex. The intronic *SE1* recruits a core repressor complex, which at the least consists of repressors (OsVAL2 and OsGD1), a co-repressor (OsSAP18), and histone deacetylase (OsHDA710), to achieve a close chromatin state at the *Eui1* locus via histone deacetylation and H3K27me3, leading to suppression of *Eui1*.

crease in high-latitude ice volume in the Northern Hemisphere.

[Li XS *et al. Sci China Earth Sci* 2018; **61**: 256–69]

MATERIALS SCIENCE

Molecular perovskites as high-energetic explosives

The difficulty in combining good detonation, high stability and low cost is the major hindrance in designing advanced energetic materials for practical uses. Wei-Xiong Zhang and Xiao-Ming Chen at Sun Yat-Sen University demonstrated a promising strategy to overcome this difficulty by presenting a new sort of high-energetic materials based on molecular perovskites. The materials achieved both exceptional detonation properties and high stability superior to the current benchmarks of military explosives, and, more importantly, could be prepared via a facile one-pot reaction under ambient conditions by using low-cost raw chemicals.

[Chen SL *et al. Sci China Mater* 2018; **61**: 1123–8]



Figure 4. Schematic of the preparation process of N-doped interconnected carbon nanosheets.

MATERIALS SCIENCE

Secondary-battery-inspired Fenton-like catalysis

Sulfate radicals with superior oxidization capacity have wide applications, but the activation of persulfate requires using Co and noble-metal-based catalysts with a suitable redox window. Yixin Zhao and co-workers at Shanghai Jiao Tong University demonstrated a successful extension of secondary-battery-inspired α -Ni(OH)₂ for environmentally friendly Fenton-like catalysis by taking the sulfate-radical generation as a charge/discharge process. The new catalyst has some key advantages over the current state-of-the-art catalysts. This finding may be extended to other secondary-battery materials as potential catalyst candidates for use in radical activation applications.

[Yue D *et al. Sci Bull* 2018; **63**: 278–81]

MATERIALS SCIENCE

Porous carbon nanosheets with self-doping nitrogen derived from biomass for supercapacitors

Supercapacitors, as novel energy-storage devices, have been developed extensively due to their high power density, long cycle life and fast charging/discharging rate. Guiling Wang at Harbin Engineering University and co-workers prepared porous interconnected carbon nanosheets using dandelion seeds, which are rich in nitrogen, but without any additional doping treatment (see Fig. 4). They further assembled this kind of carbon material into a symmetric supercapacitor that exhibits high energy density, good rate performance and good

cycling stability. This work proposes a green and low-cost carbon material and a facile preparation process for energy-storage devices.

[Zhao J *et al. Acta Chim Sinica* 2018; **76**: 107–12]

INFORMATION SCIENCE

New control strategy for precise path-following of a bionic robotic dolphin

Bionic robotic dolphins, inspired by biological dolphins, have attracted considerable attention owing to their fast and agile propulsive capabilities. Recently, Junzhi Yu and co-workers at the Institute of Automation, CAS, proposed a new control strategy for a robotic dolphin to follow some predefined paths, involving a line-of-sight guidance law, a sliding mode controller and a fuzzy strategy. Numerical analysis and experimental verification demonstrated the effectiveness and robustness of the proposed control strategy. This work sheds light on intelligent control of underwater robots in complex aquatic environments.

[Liu J *et al. Sci China Inf Sci* 2018; **61**: 024201]

Edited by Xiuling Xu