



**UNIMORE**  
UNIVERSITÀ DEGLI STUDI DI  
MODENA E REGGIO EMILIA

Dipartimento di Scienze Chimiche  
e Geologiche

# **Didattica e Comunicazione della Chimica**

Laurea Magistrale in Didattica e  
Comunicazione delle Scienze (S4EDU)

**Prof. Luca RIGAMONTI**

**A.A. 2023/24**



**DIDATTICA**

**COMUNICAZIONE**

**CHIMICA**

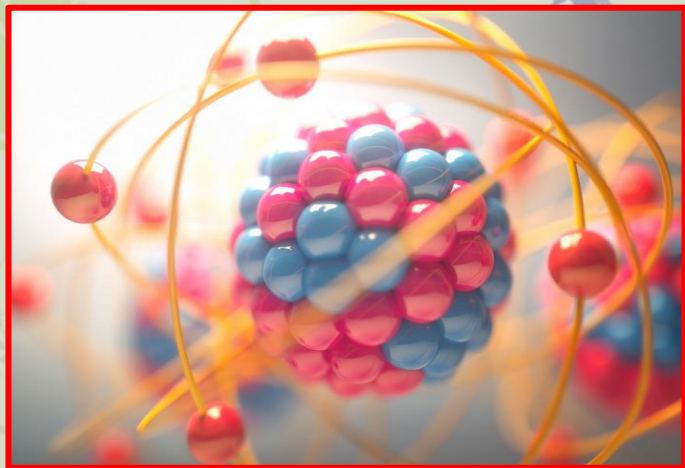
# CHIMICA

teoria atomica della materia

trasformazioni della materia

leggi ponderali e stechiometria

sistema periodico



nomenclatura chimica

geometria molecolare e teoria VSEPR

legame chimico

stati di aggregazione della materia

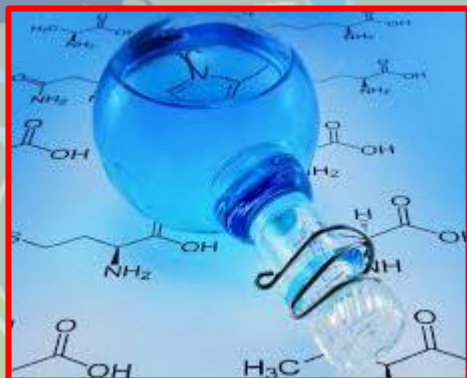
# CHIMICA

stato solido e sistemi cristallini o amorfi

soluzioni e concentrazione

acidi e basi

cinetica chimica



equilibrio chimico

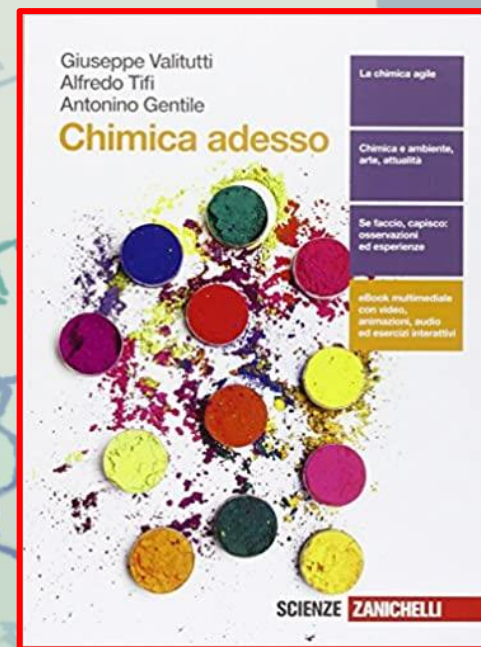
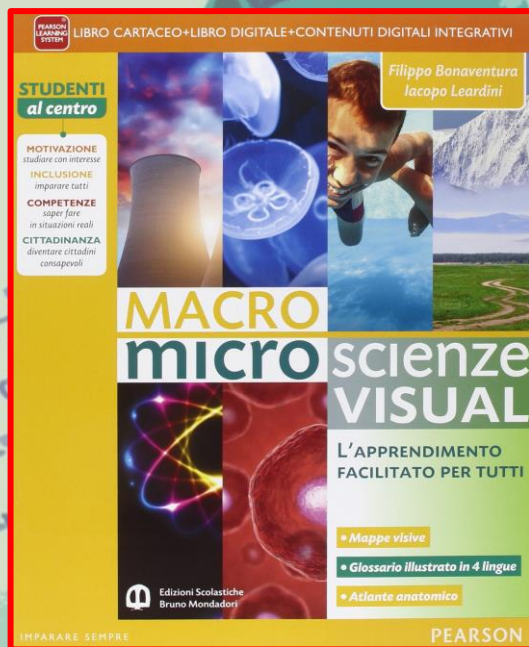
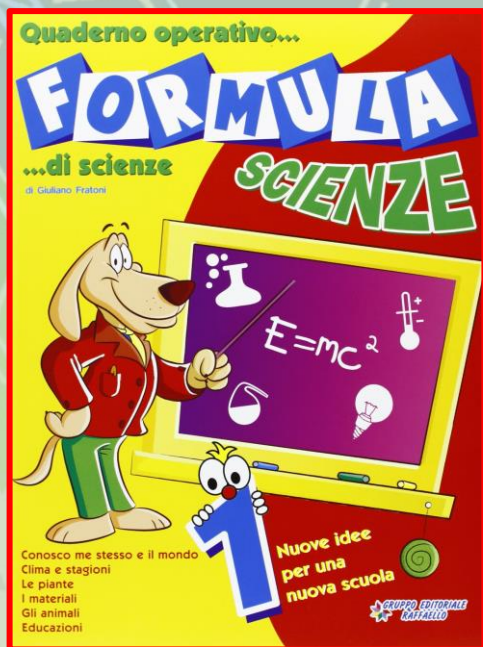
termodinamica

elettrochimica

proprietà elettriche e magnetiche della materia

# DIDATTICA

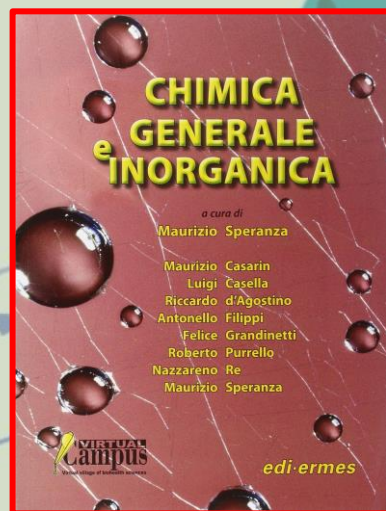
insegnamento scolastico e universitario



modulazione in funzione del livello di istruzione

# DIDATTICA

un libro si giudica dalla copertina?



# COMUNICAZIONE

divulgazione scientifica (eventi pubblici, saggistica, etc.)



# COMUNICAZIONE

giornalismo e articoli brevi

ricerca scientifica

Mercoledì 10 ottobre 2012 **iFatti** LE CITTÀ DEL MOLISE 9

## Scie chimiche, l'invasione arriva a Termoli

Sullo strano fenomeno del cielo Di Pietro ha interrogato il ministro dell'Ambiente nel 2009

**T**ERMOLI. Scie chimiche, il fenomeno interessa anche i cieli termolesi. Potrebbe sembrare una mera fantasia, una leggenda metropolitana o ancor più una storia se, perdurano a lungo nel cielo e tendono ad allargarsi in modo molto marcato. La prima protesta ufficiale contro questo fenomeno è arrivata dal Canada nel 1998, quando in se-

Chemitrails, pericolose e dannose per la salute



LA "GREEN WEEK". Oggi giornata di aziende aperte nella "Arzignano land" promossa da Unic

## Concia, la sostenibilità dalla chimica alla pelle

«È una scelta costosa ma senza investire in questo non c'è più mercato»  
«La nostra industria è ad altissimi livelli dal punto di vista ambientale»

**materials** **MDPI**

Article

### Solid-State Nonlinear Optical Properties of Mononuclear Copper(II) Complexes with Chiral Tridentate and Tetradentate Schiff Base Ligands

Luca Rigamonti <sup>1,\*,†</sup>, Alessandra Formi <sup>2,†</sup>, Elena Cariani <sup>3</sup>, Gianluca Malavasi <sup>3</sup> and Alessandro Fasini <sup>2</sup>

<sup>1</sup> Dipartimento di Scienze Chimiche e Geologiche, Università degli Studi di Modena e Reggio Emilia, via G. Campi 103, 41125 Modena, Italy; gianluca.malavasi@unimore.it  
<sup>2</sup> Dipartimento di Chimica, Università degli Studi di Milano, via C. Golgi 19, 20133 Milano, Italy; alessandra.formi@unimilano.it (A.F.); elena.cariani@unimilano.it (E.C.); alessandro.fasini@unimilano.it (A.F.)  
<sup>3</sup> Istituto di Scienze e Tecnologie Molecolari, Consiglio Nazionale delle Ricerche, via C. Golgi 15, 20133 Milano, Italy  
\* Correspondence: luca.rigamonti@unimore.it or luca.rigamonti@yahoo.com; Tel.: +39-059-205-6446

Received: 9 October 2019; Accepted: 29 October 2019; Published: 1 November 2019

Abstract: Salen-type metal complexes have been actively studied for their nonlinear optical (NLO) properties, and push-pull compounds with charge asymmetry generated by electron-releasing and withdrawing groups have shown promising results. As a continuation of our research in this field and aiming at solid-state features, herein we report on the synthesis of mononuclear copper(II) derivatives bearing either tridentate N<sub>3</sub>O Schiff bases **1** and pyridine as the fourth ancillary ligand, [Cu(L<sup>tridentate</sup>)(py)](ClO<sub>4</sub>) (**1a–c**), or unsymmetrically-substituted push-pull tetradentate N<sub>2</sub>O<sub>2</sub> Schiff base ligands, [Cu(S-A-5'-D-saldipen/chan)] (**2a–c**), both derived from 5-substituted salicylaldehydes (sal) and the diamines (R,2R)-1,2-diphenylethanediamine (dipen) and (1S,2S)-1,2-diaminocyclohexane (chex). All compounds were characterized through elemental analysis, infrared and UV/visible spectroscopies, and mass spectrometry in order to guarantee their purity and assess their charge transfer properties. The structures of **1a–c** were determined via single-crystal X-ray diffraction studies. The geometries of cations of **1a–c** and of molecules **2a–c** were optimized through DFT calculations. The solid-state NLO behavior was measured by the Kurtz–Perry powder technique @1.907 μm. All chiral derivatives possess non-zero quadratic electric susceptibility ( $\chi^{(2)}$ ) and an efficiency of about 0.15–0.45 times that of standard urea.

Keywords: chiral diamines; template synthesis; mononuclear copper(II) complexes; Schiff base ligands; nonlinear optics; Kurtz–Perry powder technique

#### 1. Introduction

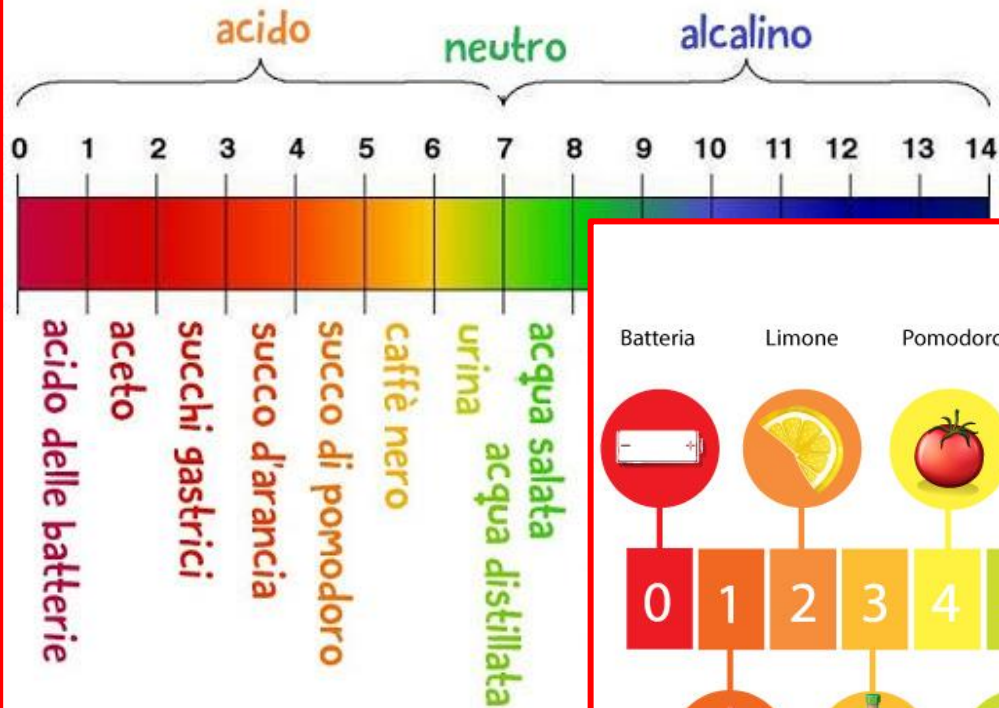
Since the generation of optical harmonics by the interaction of a ruby optical maser [1] with crystalline quartz [2], the research in the nonlinear optics (NLO) field [3] has grown exponentially [4–9]. One of the most extensively applied features of NLO materials is the generation of second harmonic (SHG) radiation, that is, the process where the frequency  $\omega$  of an incident radiation becomes  $2\omega$  when passing through the medium [3]. Molecular compounds able to show and maximize such an NLO effect in the solid state have to possess high-molecular quadratic hyperpolarizability ( $\beta$ ) values together with a non-centrosymmetric crystal packing [10], able to guarantee the final non-zero quadratic electric susceptibility ( $\chi^{(2)}$ ) of the bulk material [7,8].

Among other organometallic [11–15] and coordination compounds [14–16], salen-type [17] metal complexes have been actively studied for their NLO properties, mostly for the last two

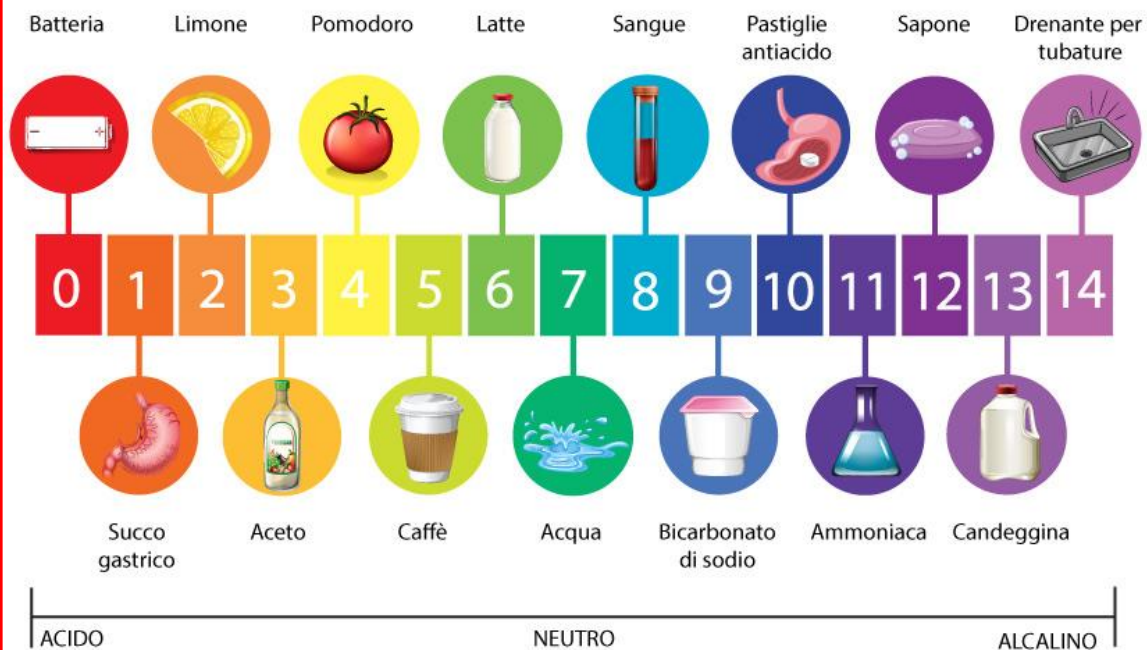
Materials 2019, 12, 3895; doi:10.3390/ma12213895 [www.mdpi.com/journal/materials](http://www.mdpi.com/journal/materials)



# VALORI DEL pH



## Scala PH



# OBIETTIVI PER LO SVILUPPO SOSTENIBILE



Agenda 2030 per lo Sviluppo Sostenibile (ONU)



**DIDATTICA**

**COMUNICAZIONE**

**CHIMICA**

[luca.rigamonti@unimore.it](mailto:luca.rigamonti@unimore.it)