Capability Development to meet Measurement Challenges

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National Research University of Information Technologies, Mechanics and Optics (ITMO University)

Measurement Standards & Technologies
Research & Development
Training & Education

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Measurement standards and technologies
National primary measurement standard of mole fraction and mass concentration of components in gas media GET-154-01

Complexes of analytical and gas-mixing apparatus

<table>
<thead>
<tr>
<th>Component</th>
<th>Measurement Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \mu_b )</td>
<td>((2.3 \cdot 10^6 - 1.6 \cdot 10^6)) %</td>
</tr>
<tr>
<td>( \Theta_0 )</td>
<td>((5.6 - 4.0 \cdot 10^6)) %</td>
</tr>
<tr>
<td>( \mu_o )</td>
<td>((2.4 - 3.0 \cdot 10^7)) %</td>
</tr>
<tr>
<td>( \Theta_0 )</td>
<td>((2.4 - 3.0 \cdot 10^7)) %</td>
</tr>
</tbody>
</table>

Comparison standards
- Pure gases, gas mixtures in cylinders under pressure
- Permeation tubes of gases and vapours
Measurement standards and technologies

Technosphere safety

Control of GHG

GET 154-01

Reference materials — PGMs in cylinders under pressure

Gas generators

Permeation tubes

Ambient Air Quality Monitoring Systems

Continuous Emission Monitoring Systems
Measurement standards and technologies
State Primary Special Measurement Standard of mass concentration of particles in aerodispersed media
GET 164-2003

Radioisotope and gravimetric system for measuring the aerosol mass concentration in the range of (0.1 – 1000) mg/m³, consisting of a high precision beta-ray mass concentration meter and a mass comparator-balance.

High-precision radioisotope mass concentration meter

System for generation of aerodispersed media with particles size in the range of (0.5 – 1000) μm, which consists of aerosol chambers (static and dynamic); optical microscope; multiple-purpose meter of disperse parameters of aerosols, suspensions and powdered materials for test aerosol media generation; flow meter; aerodynamic tunnel.

Aerosol chambers
Measurement standards and technologies
Generalized characteristics of the most common modern problems in the
field of measurement the mass concentration of particles in the scope of the
state regulation

Size of particles, µm

Mass concentration of particles, mg/m³
Measurement standards and technologies
National primary measurement standard of unit of electrical conductivity of liquids GET-132-99

The standard provides reproduction of MSD not exceeding $1 \times 10^{-4}$ in 5 independent observations.

Non-excluded systematic error not exceeding ...... $2 \times 10^{-4}$

in the range from 0,1 to 10 S/m,

..... from $2 \times 10^{-4}$ to $5 \times 10^{-4}$

in the range from 0,1 to 0,0001 S/m,

..... from $2 \times 10^{-4}$ to $5 \times 10^{-4}$

in the range from 10 to 50 S/m.
Measurement standards and technologies
National primary measurement standard of unit of electrical conductivity of liquids GET-132-99

- Monitoring desalinated water
- Radio communication with underwater objects
- Certification of the World Ocean for marine navigation
- Control of purity solvents in microelectronics and pharmaceuticals
- Monitoring weather and climate

GET 132-99

- SEC
- SALINITY

The discovery of iron-manganese nodules in marine geology
Coolant control NUCLEAR POWER PLANT

SALINITY
# Measurement standards and technologies

## List of Key Comparisons in the field of environment and climate change

<table>
<thead>
<tr>
<th>No.</th>
<th>Code</th>
<th>Description</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CCQM-K52</td>
<td>Carbon dioxide in the air at the atmospheric level (360 ppm)</td>
<td>2006</td>
</tr>
<tr>
<td>2</td>
<td>BIPM.QM-K1</td>
<td>Ozone at the atmospheric level</td>
<td>2007</td>
</tr>
<tr>
<td>3</td>
<td>CCQM-K68</td>
<td>$\text{N}_2\text{O}$ at the atmospheric level (320 ppb)</td>
<td>2009</td>
</tr>
<tr>
<td>4</td>
<td>CCQM-K84</td>
<td>Carbon oxide in the air (350 ppb)</td>
<td>2011</td>
</tr>
<tr>
<td>5</td>
<td>CCQM-K82</td>
<td>Methane in the air at the atmospheric level (2 ppm)</td>
<td>2012</td>
</tr>
<tr>
<td>6</td>
<td>CCQM-P111</td>
<td>Determination of practical salinity and mass fraction of major components ($\text{Na}^+$, $\text{Mg}^{2+}$, $\text{Sr}^{2+}$, $\text{Cl}^-$, $\text{SO}_4^{2-}$) sea water</td>
<td>2008</td>
</tr>
<tr>
<td>7</td>
<td>CCQM-P142</td>
<td>The ratio of the electrolytic conductivity of sea water and a standard solution KCl</td>
<td>2012</td>
</tr>
<tr>
<td>8</td>
<td>BIPM.QM-K1</td>
<td>Ozone at the atmospheric level (80 and 420 ppb)</td>
<td>2014</td>
</tr>
<tr>
<td>9</td>
<td>CCQM-PXXX</td>
<td>Suspended particles at the atmospheric level</td>
<td>2016</td>
</tr>
</tbody>
</table>
Measurement standards and technologies
Analysis and obtaining spectra of atmospheric gases for calibration of gas analyzers

- analysis of existing spectroscopic databases (GEISA, HITRAN), spectral atlases (The MPI-Mainz UV/VIS Spectral Atlas), and other materials;
- analysis of performance attributes and metrological characteristics of modern UV spectrophotometers;
- analysis of algorithms of spectra handling and the choose of optimal algorithm to develop a procedure to control mole fraction of components in gas media;
- acquisition of high accuracy cross-sections in UV based on own experimental investigations;
- specification of PRGM and working standards certified with the use of UV spectrophotometers.
Data Transfer in the Field of Climate Change Control

VNIIM

Scientific and methodological center for climate control
The Voeikov Geophysical Observatory

The monitoring network of ambient air quality
Moscow, St.Petersburg, Ekaterinburg, Ufa, Sochi etc.
ITMO University

Research & Development
Training and education

– Photonics and Optical Physics
– Development of Solar Cells
– Computer Technologies
– Environmental Control
Training and education

ITMO University

**FIGURES AT A GLANCE**

- **13,000** student body
- **3,500** graduate students
- **800** post-graduate students
- **1,200** lecturers, professors
- **1,200** foreign students from 26 countries
- **43** international research centers
- **6** major research fields
- **$120 million** university total budget for 2014
- **$50 million** university R&D budget for 2014

**REPUTATION**

In 2004, 2008, 2009, 2012, 2013 and 2015 ITMO University team became Absolute World Champions at ACM World Programming Contest. Up to now, the team of ITMO University is the only six-time winner of the world championship.

Out of thousands of participants only 25 world's best programmers have qualified for the final. Among them are 5 students and graduates of the ITMO's chair of computer technologies.

August 15, 2014 – ITMO students win 1st and 2nd prizes at the Google Code Jam in Los Angeles, California.

August 1, 2014 – ITMO student wins 1st prize in annual international programming championship, Yandex Algorithm, Berlin, Germany.
Training and education

ITMO University

Chair of Ecology and Technical Sphere Protection
(parented by VNIIM)

- Environment
- The instruments and methods of control of environment
- The standards and measurement technologies for the environment
- Metrology for life and sustainable development
Thank you for your attention!

谢谢您