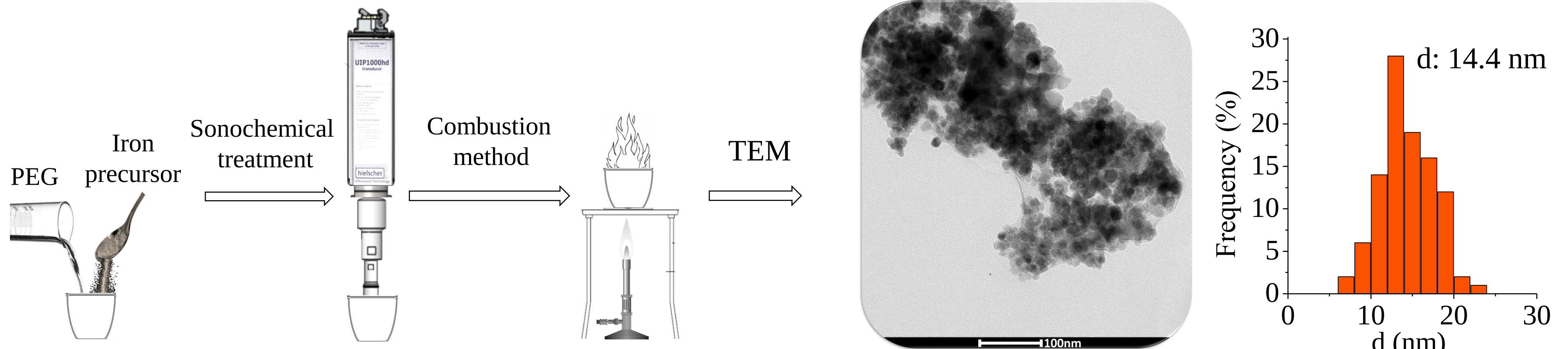


Abstract

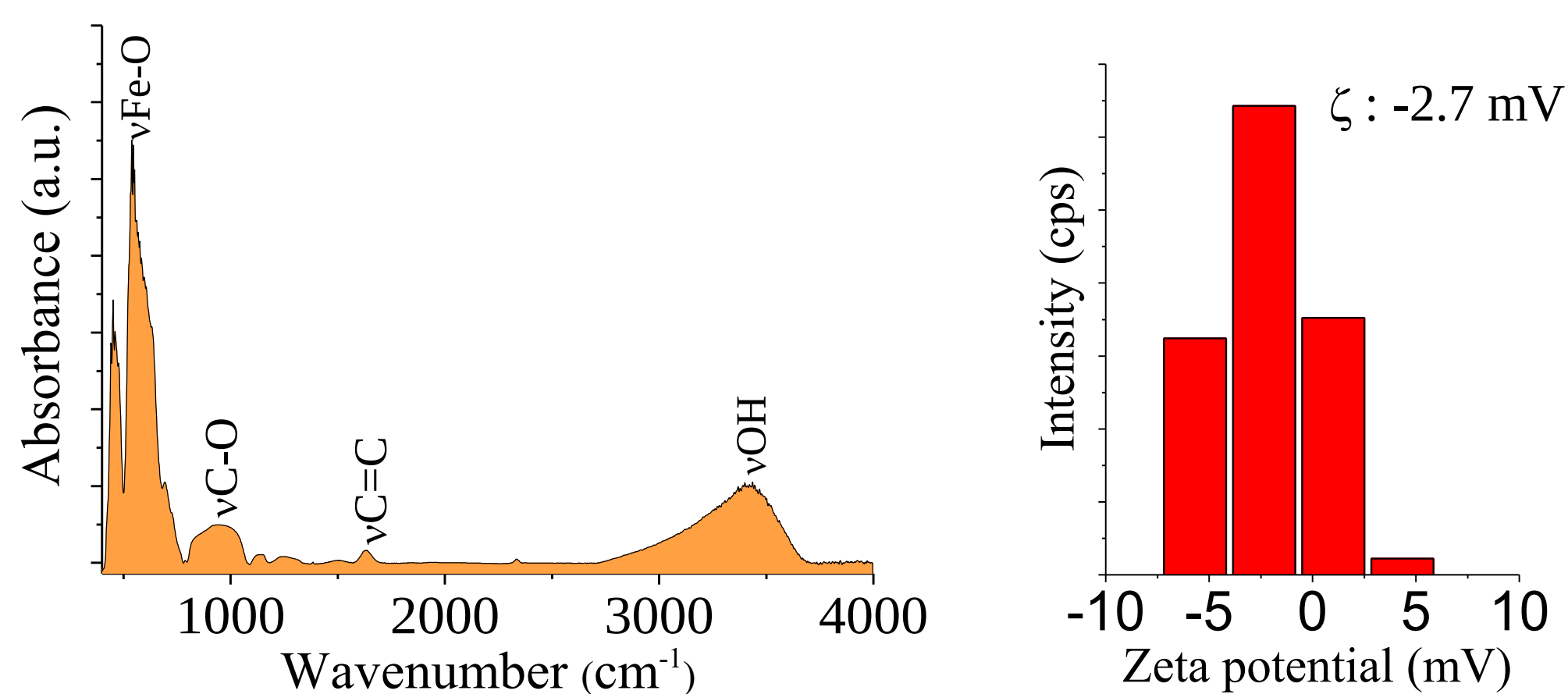
Nowadays DNA purification is still time consuming and sophisticated procedure. Commonly used centrifuge- and column-based protocols require specialized equipment, often use toxic reagents, and are not economically scalable or practical to use in a high-throughput manner. Although it has been known for some time that magnetic beads can provide an elegant answer to these issues [1]. In order to do this, superparamagnetic iron-oxide nanoparticles were prepared by a combined combustion-sonochemical method in which iron(II)-acetate was used as iron precursor. The magnetic nanoparticles were examined by X-ray powder diffractometry (XRD) and high-resolution electron microscopy (HRTEM). In XRD experiment three phases were observed: magnetite, hematite and maghemite. The maghemite phase became the largest in the produced samples. Hydroxyl groups and carbon were identified on the surface of nanoparticles. Between the hydroxyl groups of the nanoparticles and DNA hydrogen bond interaction can be formed, thus magnetic iron-oxide based nanoparticles are good candidate for DNA purification applications.

Synthesis of the magnetic nanoparticles



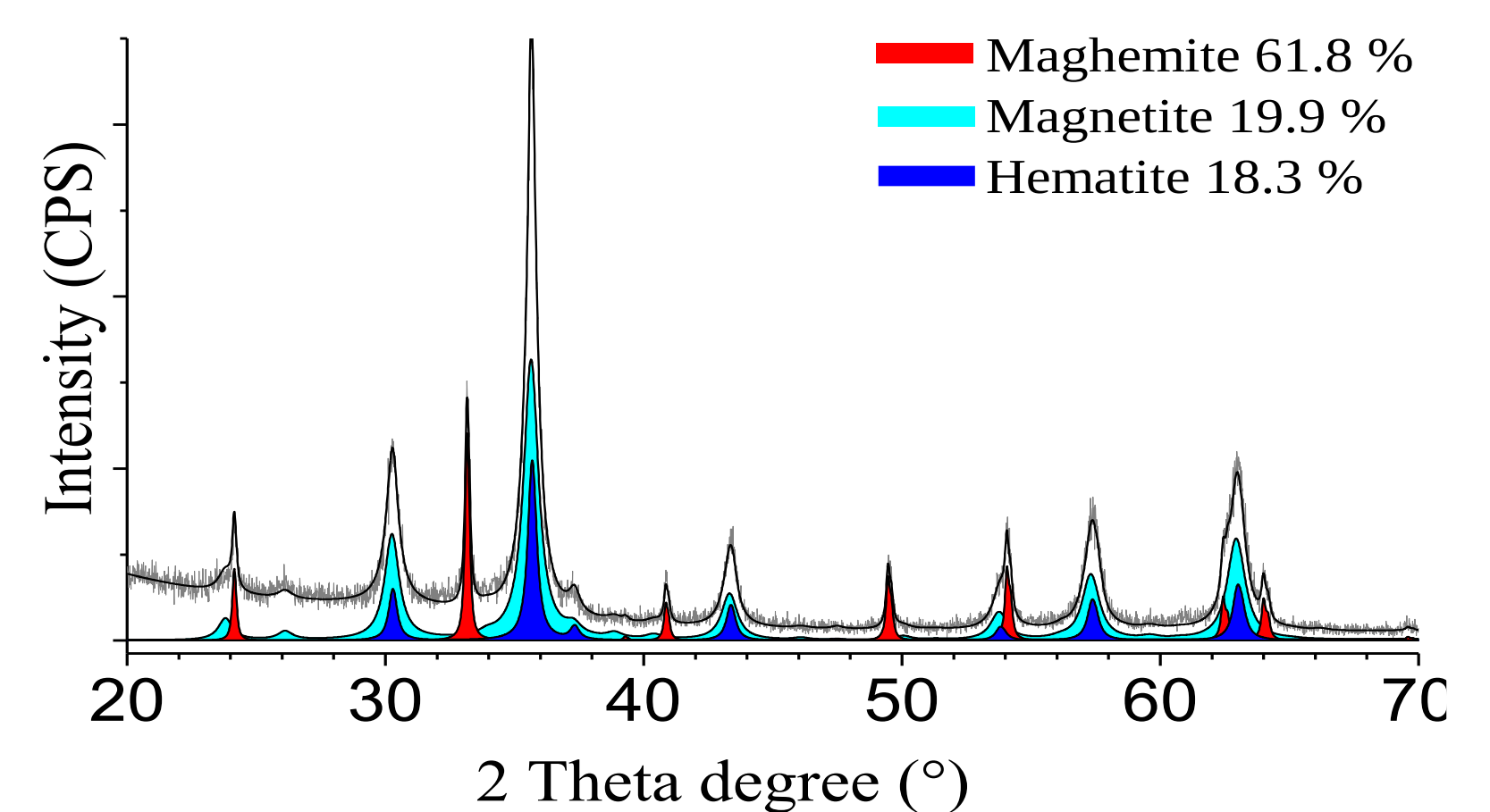
During the synthesis, iron (II) acetate was used, so that the iron nanoparticles were first dispersed in polyethylene glycol (PEG 400) by high-performance ultrasonic technique. The colloids were then burned to form iron oxide nanoparticles. The diameter of the nanoparticles was measured using an ImageJ program. The particles have a diameter of about 10-20 nm. Thus, the samples are nanostructured.

Results of FTIR and Zeta potential measurements



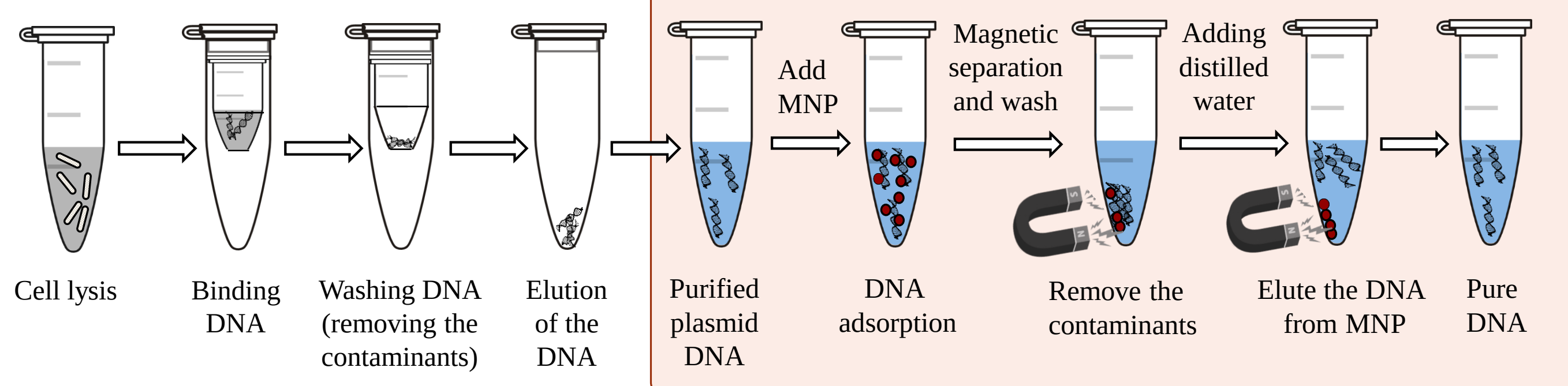
Hydroxyl groups and carbon were identified on the surface of tested nanoparticles. Presence of OH groups on the surface of the magnetic nanoparticles resulted in negative Zeta potential due to the deprotonation of hydroxyl groups. This phenomenon gives good dispersibility properties to magnetic nanoparticles in aqueous phase.

Phase identification by XRD



Magnetic nanoparticles were examined by X-ray diffraction (XRD) and high resolution electron microscopy (HRTEM). Three phases were observed in the XRD experiment: magnetite (Fe_3O_4), hematite ($\alpha\text{-Fe}_2\text{O}_3$) and maghemite ($\gamma\text{-Fe}_2\text{O}_3$). The maghemite phase was the highest in the samples produced (61.8%).

Tests of DNA binding capacity



1. Purified pBAD type plasmid DNA
2. DNA molecular-weight size marker (1 kb DNA ladder)
3. pBAD type plasmid DNA bound to and then eluted from the tested magnetic nanoparticle



DNA binding capacity of these nanoparticles produced were tested for biological applications such as DNA purification. In this experiments, purified pBAD type vector DNA was used which is a high copy number vector. The plasmid purification from *Escherichia coli* host was performed by a general plasmid purification protocol which combines the conventional alkaline-SDS lysis and a HiBind® technology. In tests of the binding of DNA to the nanoparticles, DNA was detected in the elution fraction, which means that DNA bound reversibly to these nanoparticles. After further improvements, application of such magnetic nanoparticles can provide a method for fast and simple DNA purification from complex samples.

Conclusion

Magnetic nanoparticles produced by sonochemical combustion have been shown to be suitable for DNA purification due to the favorable particle size and a favorable negative zeta potential due to OH groups. This phenomenon provides good dispersibility properties in the aqueous phase of the nanoparticles. The OH groups of the particles and the DNA hydrogen bond can be formed, so the iron oxide-based nanoparticles are good candidates for DNA purification applications.